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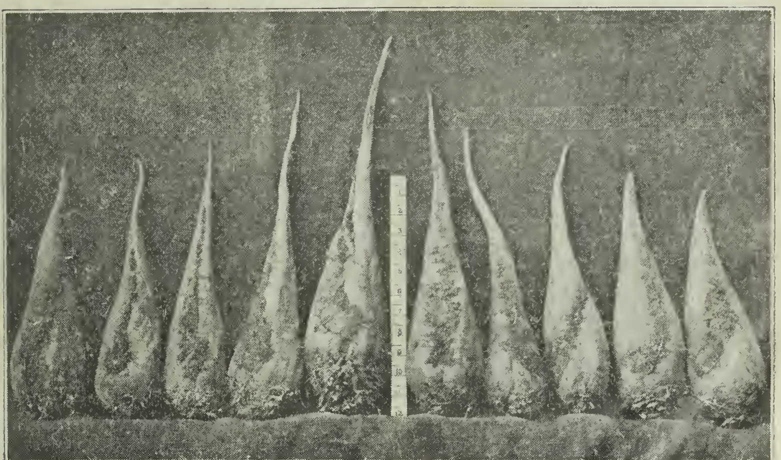

MOTHER BEETS SELECTED FOR SEED IMPROVEMENT.

SUGAR BEET CULTURE

By RUPERT L. STEWART

LAS CRUCES CITIZEN
1917

NEW MEXICO AGRICULTURAL EXPERIMENT STATION

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SUGAR BEET CULTURE

INTRODUCTION

Sugar beets have been grown in this State for many years as feed for livestock, but as all efforts were merely of a miscellaneous nature, the results thus obtained only demonstrated that the roots grew large and proved to be a very satisfactory feed.

The New Mexico Agricultural Experiment Station experimented some years ago with sugar beets on a limited scale, but the beets were planted on a rather heavy soil and the results were not very satisfactory. The factories in those days demanded a beet with a higher sugar content than they do now and as the beets grown at the Station did not test, on the average, over 14 per cent sugar, it was then considered doubtful if the raising of sugar beets for the sugar factories would be profitable.

With the improvement in the refining process, making possible the use of beets with a lower percentage of sugar in the juice, and the consequent expansion of sugar beet farming, new hopes were aroused that some districts in the State would prove profitable for sugar beet production; and to this end the business people of Las Cruces became interested, and co-operated with the Holly Sugar Company and the New Mexico Agricultural Experiment Station in giving the beets a thorough trial in the Mesilla Valley in southern New Mexico.

The plan laid out and followed was to secure growers of known reliability and farming experience in intensive methods, to plant specified acreages. And in order that it might be done on a commercial scale, one hundred acres were planted on several soil types in different

development of the crop in the early stages of the growth of the plant.

Preparing the Seed Bed.

> *"The proper leveling of the land is fully as important with this as with any other crop, and upon this feature of the work the securing of the best yield will very largely depend. It is far better for the beginner, if funds are limited, to restrict his area to a small acreage and put it in proper shape than to endeavor to handle a large area of poorly prepared land, and meet with partial failure. In the latter case, he will not only encounter difficulty in distributing the irrigation water evenly, thereby causing needless labor and trouble, but with unevenness in the surface, it will be impossible to prevent the drowning out or scalding of his crop in the depressions."

Too much of the land in this section has been improperly leveled and necessitates releveling before the best results can be secured from sugar beets.

All sections are agreed on the necessity of deep fall plowing. However, **"if the soil has never been plowed deep, the plowing should be only 1 to 2 inches deeper than before. It is not wise to turn up too much new soil." If the land has not been fall plowed, deeper plowing may be practiced, for fall plowed land is exposed to the weathering agencies for a much longer time, thereby giving the soil time to become aerated and thus rendered more fertile and productive.

It is usually a good practice to allow the plowed fields to remain in their rough condition until spring, as the frost and the rain or snow have a beneficial effect on

*Farmers' Bulletin 392, U. S. Department of Agriculture.

**"Essentials of Beet Farming," by H. Mendelson, of the Great Western Sugar Company.

the soil thus exposed. In early spring, a disk should be used to pulverize the soil. It is oftentimes advisable to irrigate before disking; especially is this true if the winter has been dry. Whether the land is irrigated or not, it should be plowed again in the spring, but not quite so deep as in the fall. It is well to harrow or float the ground down fresh, thereby packing and settling it and making a fine seed bed, which should be reasonably firm so that when a person of ordinary weight walks over it, the impressions are very little over the shoe soles.

> *"Alfalfa sod cannot be put in the best shape for beets with only one plowing. It is necessary to kill all the alfalfa. If this is not done properly, it will come up again almost as fast as the beets, making trouble for the cultivator, and necessitating more hand work. Alfalfa sod before being plowed deep should be 'crowned.' This means plowing just deep enough to cut off the crowns of alfalfa with a sharp plow share, so that the crowns remain on the top of the ground and dry out completely. Harrowing a few days after crowning will bring to the surface the crowns that have been buried too deep. After the crowns are dead, the land should be plowed again at a reasonable depth."

Crowning should be done in the fall, if possible. However, if this cannot be done, the work should be done as early in the spring as possible. Care should be exercised in securing only sharp plow shares, otherwise the plowing will be very hard on the horses.

Land having raised one or more grain crops is often too dry to plow, and also contains a considerable number of weed and grain seeds. In such case, it is advisable to irrigate before plowing, as this causes the weed seed

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*"Essentials of Beet Farming," by H. Mendelson.

to sprout, and the small weeds are then killed by the plow. Whenever possible, manure should be applied. If the manure has much straw, it should not be used in late spring plowing, as this often makes a layer between the moist subsoil or second soil, and the dry top soil, and in this way prevents the moisture from rising. Well rotted or finely broken up manure is beneficial when applied as a top dressing and disked or plowed in, either in the spring or fall.

Seeding.

The ordinary four-row force feed beet drills made by various manufacturers are required for the planting of beet seed. These drills are all of the shoe type, as the disk is not necessary when the soil is properly prepared. The seed is planted to a depth of an inch to an inch and a half, depending upon the character and dryness of the soil. Experience shows that if the seed is planted too deep, the beets will have difficulty in getting through, and are very apt to be weak and subject to heavy losses by dying out. In the heavier soil, shallow planting is necessary, as rains or irrigation water will crust the surface of the soil and prevent the beets from coming up well. Sometimes it is necessary to run a light tillage implement over the newly planted and irrigated field as soon as it has dried sufficiently to allow a team to walk on the field without sinking.

In the lighter soils, there is less danger of a heavy crust forming. With new drill shoes, it is easy to plant too deep. It is therefore a good practice, when starting, to ascertain by digging in the row behind the drill, how deep the seed really is buried. It is also necessary to watch whether the seed goes out into the drill tube, as small sticks sometimes clog up the outlet, and uneven planting is the result. It is always a good plan to attach the furrowing shovels when planting, so that small fur-

rows will be made between the rows, as this is the only way that one can tell just where the rows are, and this is necessary in case the harrow or some similar instrument is used in breaking the crust before the seed germinates.

When drilling, it should be remembered that the beets have to be cultivated when hardly visible, and very close to the row. To do this properly, without cutting out plants with the cultivator, the rows must be straight. The first run with the drill must be driven with particular care, and it is usually well to use a marker, so as to get the rows straight. An inexperienced driver should never be allowed to seed the field to beets. In some cases the sugar companies furnish experienced drivers for this operation, but this is not necessary if the farmer uses care in doing the work.

The beets are usually drilled in rows 18 to 22 inches apart. The best spacing of rows is such as will permit continuous cultivation. The quantity of seed sown varies somewhat, but 15 to 20 pounds are usually recommended by the sugar companies.

Method of Irrigating.

The border system of irrigation under flooding methods has been practiced almost entirely in this locality, and there was a great deal of skepticism as to whether or not the furrow method would be successful.

> *"When the river carried water heavy with silt, the border system was the only practical way to irrigate, for the ground became so quickly coated over with sediment that the water did not percolate to any considerable depth until it had stood many hours on the field."

However, this condition has changed. The water now used for irrigation purposes carries but little silt in

*From Phil Erickson's report to the Holly Sugar Company.

suspension, the greater part of it having been deposited in the reservoir behind the Dam, and it is found that the clear water sub-irrigates quite as well as it does in other beet growing districts.

The furrow method of irrigation has, without doubt, given the most satisfactory results in a large majority of beet growing districts, and where irrigation is to be practiced during the growing season, the furrow method is by far the best method to follow. It is acknowledged by all experts that water should not be allowed to touch the young plants. The ideal condition is brought about by the maintenance of a continuous mulch close to the beet itself, so as to prevent evaporation from the soil, and by cultivation after irrigation to break up the wetted area in the furrow.

To irrigate properly in furrows, the land should be given a uniform slope, so that the water will run through the furrows without difficulty. In plowing the land, care should be exercised to eliminate as many dead furrows as possible. Back furrowing into them will help over-

Fig. 1.—Land must be Properly Leveled in order to Practice the "Furrow" Method of Irrigation Successfully.

come this, but if possible, a two-way plow should be used and the dead furrow done away with entirely. After plowing, the disk harrow should be used to break up the clods and firm the soil, and if the field is fairly level, a homemade float, if properly used, will put the ground in good shape.

The ditches, or furrows between the rows, are made with the shovel attachment of the cultivator. They should be deep enough to carry sufficient water and prevent the water from flooding the soil between the rows. It may be necessary to furrow out several times during the season.

Time of Irrigating.

It is, of course, necessary that there be sufficient moisture in the soil to germinate the seed properly, and in this locality, where evaporation is go great, attributable largely to the numerous spring winds, it is best to irrigate immediately after seeding and then by running some light tillage implement over the surface, breaking the crust. The next irrigation should be delayed as long as there is sufficient moisture in the soil to keep up a steady growth. Too early irrigation has a tendency to make a turnip shaped beet,—that is, the roots do not grow down deep enough; while withholding water has a tendency to force the plant to secure moisture with its tap root, and thus grow deeper into the soil. Care must be taken, however, not to hold the water off too long, as the beets will begin to mature, and so prevent proper development. There can be no fixed rule laid down for irrigating, but the past year's results indicate that there is a tendency on the part of the growers to withhold the water too long during the hot summer months.

A common practice in some beet growing states is to withhold the water till the leaves wilt, but this is not

to be advised in this locality, where evaporation is so great. Beets in this section require more frequent irrigations than they do in Colorado. Inexperienced beet raisers frequently stop irrigation when it rains. This is a mistake. Rains in our arid districts in July and August seldom provide as much moisture as is necessary and advisable to apply in one irrigation.

Cultivating.

As soon as the beet rows are visible, cultivation should begin. The special beet cultivator should be used, and in giving the first cultivation, it is always best to use the ridging disk attachment. It is desirable, in the first cultivation, to cultivate as close as possible to the row without destroying or covering the plants with dirt.

Fig. 2—Cultivating Experimental Beet Plots with Four-row Cultivator.

Much care should be exercised in the first cultivation, and this work should be done rather slowly at first, for the better the first cultivation is done the easier will be the subsequent operations. Beets should be cultivated shallow to exterminate the weeds, until about ten days after thinning; at which time, one should endeavor to start in with deeper cultivations; being careful, however,

that none of the beets are covered up. As the plants grow, the cultivations should be further away from the plants, so as not to endanger the lateral roots too greatly, for if they are continually pulled off, it will retard the development of the beet considerably. Cultivation should take place after each irrigation, in order to keep the ground in a mellow condition between the beets. It is often advisable to cultivate between irrigations; the number of times, of course, depending on conditions; but the ground should be kept loose on the surface at all times, and there should be no hard layer just below the mulch. No weeds should be allowed to grow in the field at any time. Cultivation will, of course, have to be stopped when the foliage becomes so large as to overlap in the rows. Beets, to grow well, must have a well aerated soil, which can be secured only by persistent and timely cultivation.

Blocking and Thinning.

About four or six weeks after the planting, beets should have attained the size of four to six leaves, at which time they are ready for thinning or singling to one plant, the aim being to leave one beet about every 10 to 12 inches in the row. This is accomplished first by blocking, which means chopping out the beets with a hoe so that bunches remain about 12 to 14 inches apart. A short handled hoe is usually used in doing this work, and the beets are chopped out at one stroke. The remaining bunched plants are then thinned down to one by removing all others by hand. The strongest plants should always be left. As this work is usually done in a hurry, some of the smaller plants are often overlooked, but these may be removed at the time of the second hoeing. It is imperative that only one beet be finally left in a place, as beets that are crowded will be stunted. The beets should be irrigated soon after thinning, and then deeper cultivation commenced.

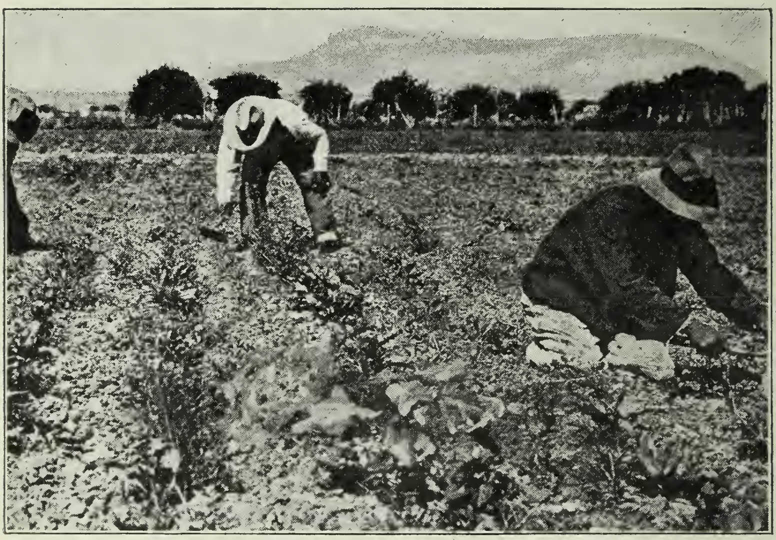

Fig. 3.—Blocking and Thinning the Beets.

All weeds should, of course, be cut out at the time of thinning, but in fields where weeds are persistent, a second and maybe a third hoeing will have to be given. Cultivation at this stage of the growth is of the utmost importance, and pays for itself many times over in the increased yield.

Harvesting.

The harvesting begins when the beets are ripe, and this condition, of course, depends to a large extent on the time of the planting and the climatic conditions. Beets planted about April 15 should be ready to harvest about the middle of September. Fully matured beets will show a yellowish green cast, but the saccharine content can only be determined by a chemical test.

There are several types of implements made use of in harvesting beets, but the one most commonly used is known as the beet puller or lifter.

Fig. 4.—Pulling Sugar Beets.

The beet puller is made in the shape of a plow, with two handles, and two wheels are attached to the front of the puller on bars, which can be raised or lowered; thus regulating, to some extent, the depth to which the puller points go. The beet pullers have removable wedge shaped points, and these points must be kept sharp, as they run along under the ground on either side of the beet and lift it just enough so that a man can easily pull it. They should not be thrown entirely out of the soil.

After the beets are lifted, the laborers pull them, two at a time, knock them together to remove all dirt possible, and throw them in piles.

Topping.

The topping consists of removing with a blow of the knife the crown from the body of the beet at the point of the last leaf, and throwing the topped beets on a cleared space so that no foreign matter will be included when the beets are loaded into the wagon.

Beets should be loaded with a fork made especially for this purpose. A minimum amount of dirt should be placed in the wagon, as the company, of course, does not pay for the dirt, but determines the weight of the same and deducts it from the gross weight of the beets.

Siloing.

Sometimes it is found necessary to pull the beets before the factory is ready to use them. This condition may be brought about by the fact that the ground is wanted for some other crop, or it may be that freezing weather has set in and renders it unsafe to leave the beets in the ground. The latter case, however, will rarely, if ever, apply to the valleys of southern New Mexico, as there is usually not enough cold weather to affect the beets that are left in the ground.

Keeping the beets on the farm after they have been dug, is usually called siloing. In some cases, the factory pays for this additional work. The beets are usually hauled to a convenient spot, where a pile four to six feet wide, three to four feet high, and as long as necessary, is made and covered with three to six inches of dirt; depending, of course, on the weather. Sometimes the beets are put into smaller piles in the field where grown. In such cases, there is usually not more than 1,000 pounds to any one pile.

If siloing is properly done, the beets will keep in good condition until orders for delivery are issued.

Crop Rotation and Fertilizers.

In order to maintain the fertility of the soil and so keep it productive, the same crop must not be grown on the same field from year to year. Continuous cropping will eventually cause the soil to become unproductive. The beet is a heavy feeder, and as a large tonnage is removed from the field each year, it can be readily seen

that some system of crop rotation should be practiced. Alfalfa, which is the principal crop throughout the irrigated areas of this State, is an excellent crop to use in the rotation, because it is deep rooted and fertilizes the soil by its nitrogen-fixing properties. No definite rotation with beets has as yet been worked out in this State, but it is a problem that in time will require attention.

The only fertilizer extensively used in other beet growing sections is manure, and excellent results are secured.

The feeding of cattle and sheep with the beet tops, pulp, alfalfa, and waste molasses from the factories, is a common practice, and, as a result, a large quantity of manure is produced on the farms, which keeps the soil in a high state of fertility.

CLIMATE.

The climate of this section of the State is usually mild in winter and although the mercury runs quite high in the summer months, the nights are cool. The extreme heat is usually in the months of June and July.

The records taken at the Station show that the average number of clear days in the year is 215, partly cloudy days 107, and cloudy days 43.

Figure 5 shows the comparative maximum and minimum annual temperatures at stations in the Mesilla Valley, New Mexico, and those of Fort Collins and Rocky Ford, Colorado.

The following, taken from New Mexico Experiment Station Bulletin No. 59, will give some idea of the relative humidity of this section: "By 'relative humidity' is meant the percentage of moisture present of the total amount that the air could hold at that temperature. Relative humidity is of great importance, not only to persons

seeking dry climates from considerations of health, but also to the farmer. An extremely dry atmosphere means an increased loss of water from reservoirs and from the soil. Larger amounts of water must be used in irrigation when the air is abnormally dry. Bulletin 0, U. S. Weather Bureau, gives the annual mean from 1891-1904 for El Paso, Texas, as 38.8 per cent. The low relative humidities are, of course, found only in the arid region. Independence, Cal., has an annual mean relative humidity of 29.7 per cent; Denver, Colo., 48.7 per cent; Carson City, Nev., 50.2 per cent; Salt Lake, Utah, 52.8 per cent; Los Angeles, Cal., 71.7 per cent; and Jacksonville, Fla., 79.5 per cent."

The mean relative humidity for the year 1916 was 37.8 per cent. Table 2 gives the mean relative humidity by months for the year, together with the total monthly precipitation.

TABLE 1.—COMPARATIVE STATEMENT OF TEMPERATURES.

Month	Mesilla Valley, N. M.			Ft. Collins, Colo.			Rocky Ford, Colo.		
	Mean Max.	Mean Min.	Mean	Mean Max.	Mean Min.	Mean	Mean Max.	Mean Min.	Mean
January	58.5	23.2	42.2	41.4	11.9	26.5	47.0	14.8	30.0
February	61.7	26.9	46.4	41.5	12.2	26.6	48.4	15.3	31.5
March	69.3	32.8	53.5	50.5	22 5	36.4	59.7	24.9	42.3
April	77.7	39.3	61.2	61.0	31.7	46.3	68.3	35.1	51.6
May	85.5	46.9	70.3	68.1	40 4	54.3	76.1	44.5	60.1
June	94.0	56.4	78.9	78.5	48.1	63.5	86.4	54.1	70.4
July	93.3	62.5	80.8	83.8	52 9	68.3	90.5	58.6	74.5
August	92.1	61.2	79.4	83.9	51.4	67.5	90.1	57.1	73.5
Septemer	87.1	54.2	73.0	77.0	42.8	59.7	83.4	48.9	65.9
October	77.2	41.0	62.0	64.6	32.0	47.9	71.0	34.6	52.8
Novemer	67.8	29.7	49.5	51.1	20.8	35.6	57.1	22.6	39.8
December	57.8	23.7	42.5	43.4	14.6	28.9	46.7	14.2	30.6

Note.—The mean maximum and mean minimum temperatures for the Mesilla Valley are from Bulletin 59 of this Station, and cover a period of about 46 years; while the mean temperatures for this Valley are for approximately 14 years. The records were made at Fort Fillmore, Fort Selden, Mesilla and State College, N. M.

The Colorado temperatures are from Bulletin 182 of the Colorado Agricultural Experiment Station; those for Fort Collins covering a period of 25 years, and for Rocky Ford, about 23 years.

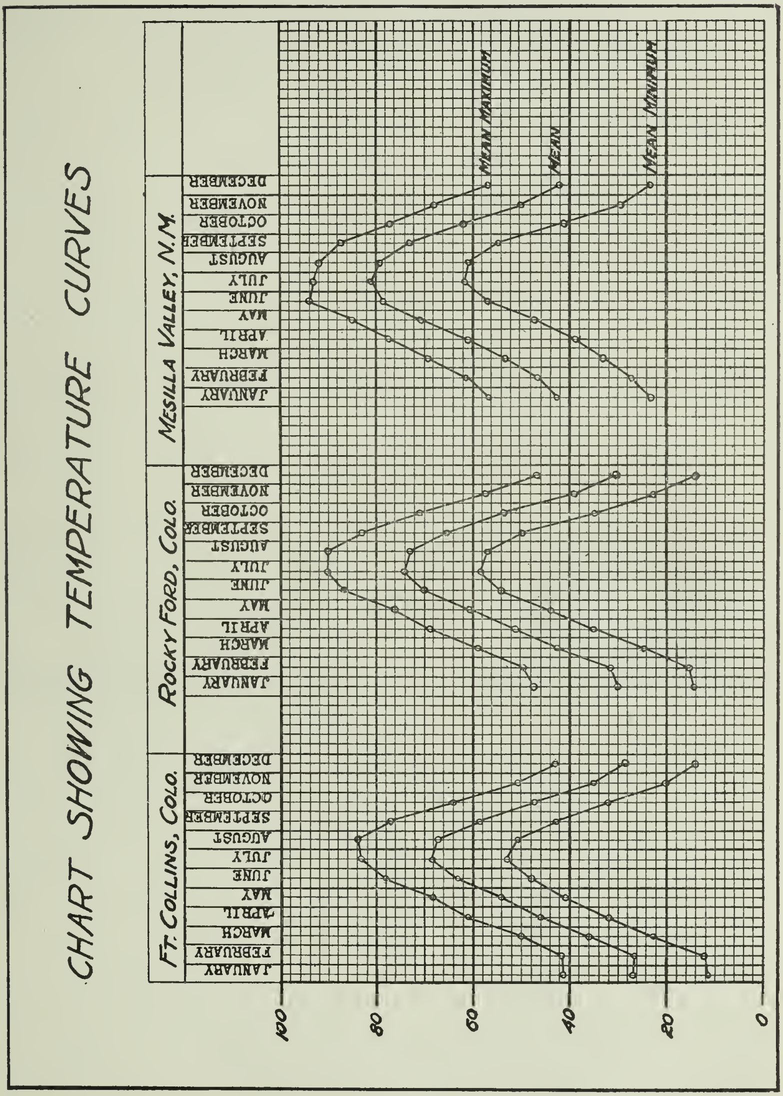
CHART SHOWING TEMPERATURE CURVES
Ft. Collins, Colo.
Rocky Ford, Colo.
Mesilla Valley, N.M.
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
MEAN MAXIMUM
MEAN
MEAN MINIMUM
100
80
60
40
20
0

Fig. 5.

TABLE 2.—TEMPERATURE, MEAN RELATIVE HUMIDITY, AND PRECIPITATION, 1916; AS RECORDED AT STATE COLLEGE, N. M.

Month	Temperature; Deg. Fahr.					Mean Relative Humidity; per cent.			Precipitation (total); inches
	Mean Maximum	Mean Minimum	Mean	Maximum	Minimum	A. M.	P. M.	Monthly	
January	60.8	34.0	47.4	73	14	68.0	41.9	54.9	.25
February	67.6	32.2	49.9	80	9	52.4	22.6	37.5	.18
March	73.5	40.1	56.8	86	28	41.1	19.2	30.1	.67
April	76.1	43.1	59.6	87	31	42.4	20.5	31.4	.07
May	85.6	47.8	66.7	97	36	36.6	13.7	25.1	.97
June	97.5	58.2	77.8	103	41	25.6	10.1	17.8	.00
July	93.7	65.6	79.6	104	56	46.3	29.1	37.7	.50
August	90.2	64.0	77.1	96	58	65.9	36.8	51.3	1 28
September .. .	85.8	55.9	70.8	91	43	54.6	32.2	43.4	.69
October	77.4	46.0	61.7	90	33	51.9	35.2	43.5	2.50
November	65.9	27.6	46.7	83	14	52.6	28.0	40.3	.52
December	56.4	23.7	40.0	71	9	52.2	29.0	40.6	.15
Total for year									7.78

RESULTS OF EXPERIMENTS CONDUCTED AT THE NEW MEXICO AGRICULTURAL EXPERIMENT STATION.

Early in 1916 quite an extensive experiment was started in an effort to determine the best method of growing sugar beets and to study the effect of the low relative humidity and high temperature upon the yield and sugar content of the beets and purity of the juice.

Three types of soil were selected for this purpose: a light sandy soil, a silt loam, and a moderately heavy adobe. There were three plantings made on both the sandy soil and the adobe: one in December, 1915; one in January, 1916; and one in February, 1916. On the silt loam soil the plantings were commenced on March 15 and continued at fifteen-day intervals for the remainder of

Fig. 6.—Beets Planted January 21, 1916, on Horticultural Farm, New Mexico Agricultural Experiment Station. Picture taken May 15.

the season. This field had been seeded to alfalfa the previous spring but a very poor stand was secured, and in January, 1916, the land was plowed, double disked, harrowed and floated both ways, in order to work it down to a good seed bed for beets.

The beets were seeded in rows twenty inches apart, at the rate of twenty pounds of seed to the acre.

TABLE 3.—RESULTS OBTAINED UNDER DIFFERENT DATES OF PLANTING AND DIFFERENT METHODS OF IRRIGATION

Plot No.	Date Planted	Stand	Average Weight of Beets; lbs.	How Irrigated
1	March 15	Fair	.91	Flooded after planting.
2	March 15	Fair	1.53	Furrow after planting.
3	March 15	Fair	1.89	Planted in moist seed bed.
4	April 5	Good	2.17	Flooded after planting.
5	April 5	Fair	2.24	Furrow after planting.
6	April 5	Fair	2.42	Planted in moist seed bed.
7	April 15	Fair	3.32	Flooded after planting.
8	April 15	Fair	2.20	Furrow after planting.
9	April 15	Good	3.64	Planted in moist seed bed.
10	May 1	Best	4.35	Flooded after planting.
11	May 1	Good	3.56	Furrow after planting.
12	May 1	Good	2.24	Planted in moist seed bed.
13	May 15	Fair	1.32	Flooded after planting.
14	May 15	Fair	1.84	Furrow after planting.
15	May 15	Poor	2.31	Planted in moist seed bed.

It will be noted from the above table that the best stand was secured on the plots that were planted May 1. Very little difference was noticed in the stand under the different methods of irrigation; however, a harrow was used to break the crust on the plots that were flooded. The seed was slow in germinating in the plots where it was planted in a moist seed bed and not irrigated.

Analyses made at the New Mexico Agricultural Experiment Station.

In order to determine, if possible, the average sugar content and purity of juice of the beets planted on different dates, arrangements were made with the Chemical

Department, whereby samples were taken every ten days and analyses made in the laboratory. Care was exercised in selecting the beets, the same man doing this work each time, in order that the same type of beet might, in each instance, be used for the analytical work.

The beets used for the tests were selected to represent the average as to size and maturity at the time of collecting the samples. Those selected were at once taken to the laboratory, cleaned of dirt, topped, weighed and tested. In cases where the sample was made up of three or more beets they were quartered, otherwise the whole beet was used. The sample was shredded and the juice was extracted by means of a press. The specific gravity of the juice was determined by means of the Westphal balance and the sugar content by the polariscope.

By purity is meant the ratio of sugar to the total amount of solid matter in the juice. For example, if ten pounds of juice give eight pounds of water and two pounds of solid matter, and this solid matter contains one and six-tenths pound of sugar, then the purity would be eighty per cent. Purity is sometimes spoken of as "Coefficient of Purity" or as "Exponent."

The average of all samples tested on the different plats gives 13.1 per cent sugar content and 79.1 per cent purity. These results are low, just as should be expected, for the tests were begun before the beets reached maturity and were continued long after the period of maturity had passed. The tests were extended over this long period in order to show the time of optimum conditions. The maximum sugar content was 20.3 per cent. and the maximum purity 94.2 per cent.

The average of twenty-eight samples tested under similar conditions for farmers who raised their beets mostly near the Experiment Station and on similar soil,

gave 13.0 per cent. sugar and 78.6 per cent. purity. Twenty-two samples that were exhibited at the Dona Ana County Fair during the fall of 1916, in competition for prizes, gave an average of 15.9 per cent. sugar content and 78.3 per cent. purity. These twenty-two samples were tested under the same conditions as the others, with the exception that the beets stood about a week before they were tested.

Our first year's tests show that the beets grown on heavy soil are lower in sugar content and in purity than those grown on light soil.

The results given in the table for the plats west of the Agronomy Department buildings are the most significant of all, for the reason that they represent the largest number of beets. In these figures it will be observed that the maximum sugar content, 20.3 per cent., was obtained on the beets planted May 1. The maximum purity, 87.3 per cent., was obtained on the beets planted April 15.

In the plats on the Horticultural Farm the maximum sugar content was 17.5 per cent., obtained from the plantings of January 23; and the maximum purity was 94.2 per cent., obtained from the plantings of February 23. The soil in these plats was light. In the plats southwest of the Agronomy buildings the maximum sugar content was 19.2 per cent., obtained from the plantings of February 23; and the maximum purity was 86.8 per cent., obtained from the plantings of January 23. The soil in these plats was moderately heavy adobe.

TABLE 4.—SHOWING AVERAGE WEIGHTS OF BEETS, SUGAR CONTENT, AND COEFFICIENTS OF PURITY UNDER DIFFERENT DATES OF PLANTING AND DIFFERENT PERIODS OF ANALYSIS.

Date of Planting	Date of Analysis	Average Weight of Beets; lbs.	Average Per Cent Sugar	Average Per Cent Coefficient of Purity	Maximum Sugar (per cent.) and Date of Test	Maximum Purity (per cent.) and Date of Test
Beets Grown on Horticultural Farm, New Mexico Agricultural Experiment Station.						
Dec. 23, '15	Jul. 20-Aug. 21	1.97	13.1	80.5	(16.2,	(84.4,
Dec. 23, '15	Aug. 21-Sept. 11	1.96	13.4	79.3	(Aug. 31	(Aug. 31
Jan. 23, '16	Jul. 20-Aug. 21	2.32	12.9	80.3	(17.5,	(90.2,
Jan. 23, '16	Aug. 21-Sept. 11	2.09	13.3	82.8	(Jul. 21	(Aug. 31
Feb. 23, '16	Jul. 20-Aug. 21	2.21	13.1	84.7	(15.0,	(94.2,
Feb. 23, '16	Aug. 21-Sept. 11	2.25	13.8	85.6	(Aug. 31	(Aug. 31
Grown on Plats Southwest of Agronomy Buildings, New Mexico Agricultural Experiment Station.						
Jan. 23, '16	Jul. 22-Aug. 23	2.14	13.2	79.4	(14.5,	(86.8,
Jan. 23, '16	Aug. 23-Sept. 27	2.84	12.9	77.8	(Aug. 12	(Aug. 12
Feb. 23, '16	Jul. 22-Aug. 23	3.49	13.8	80.0	(19.5,	(83.0,
Feb. 23, '16	Aug. 23-Sept. 27	3.27	12.5	77.9	(Jul. 22	(Jul. 22
Grown on Plats West of Agronomy Buildings, New Mexico Agricultural Experiment Station.						
Mar. 15, '16	Jul. 21-Aug. 21	1.24	13.1	79.6	(	(
Mar. 15, '16	Aug. 21-Sept. 21	1.43	12.5	79.3	(	(
Mar. 15, '16	Sept. 21-Nov. 6	1.96	13.8	76.6	(16.5,	(84.3,
Mar. 15, '16	Nov. 24-Dec. 27	2.34	14.5	75.2	(Jul. 21	(Aug. 11
Apr. 1, '16	Jul. 22-Aug. 21	1.26	11.6	76.5	(	(
Apr. 1, '16	Aug. 21-Sept. 21	1.70	11.9	75.9	(	(
Apr. 1, '16	Sept. 21-Nov. 10	2.71	14.1	76.3	(16.2,	(82.9,
Apr. 1, '16	Nov. 24-Dec. 27	2.70	14.6	73.9	(Nov. 10	(Sept. 1
Apr. 15, '16	Jul. 24-Aug. 22	1.39	11.6	77.8	(	(
Apr. 15, '16	Aug. 22-Sept. 22	1.92	12.2	78.5	(	(
Apr. 15, '16	Sept. 22-Nov. 10	2.21	15.5	77.3	(17.0,	(87.3,
Apr. 15, '16	Nov. 25-Dec. 27	2.62	14.4	75.4	(Nov. 10	(Aug. 11
May 1, '16	Sept. 12-Oct. 20	1.48	12.6	77.5	(	(
May 1, '16	Oct. 20-Nov. 25	2.65	15.2	77.7	(20.3,	(84.1,
May 1, '16	Nov. 25-Dec. 28	2.23	14.8	78.8	(Nov. 11	(Sept. 25
May 15, '16	Sept. 13-Oct. 20	2.49	13.2	78.1	(	(
May 15, '16	Oct. 20-Nov. 15	2.45	15.0	77.3	(17.9,	(80.6,
May 15, '16	Nov. 25-Dec. 28	2.69	15.0	76.2	(Nov. 11	(Sept. 25
June 1, '16	Dec. 28	2.38	14.0	70.3		
June 15, '16	Dec. 28	1.59	14.4	80.0		
July 1, '16	Dec. 28	3.15	10.5	63.6		

Analyses Made by Sugar Company.

The table below shows the results of the analyses made in the laboratories of the Holly Sugar Company, of the beets shipped in carload lots from the Mesilla Valley to the factory.

The samples for the sugar tests were secured in this manner: as each wagon load was being loaded into the car, twenty-five average beets were sacked and sent to the factory by freight. These figures, of course, show the results of analyses made on beets that had been dug five or six days, and naturally, the percentages of sugar are slightly higher than if the analyses had been made immediately after the beets were dug.

It will be noted from this table that the average tare on the beets shipped to the factory was quite low,—much lower than is usually found. This is a good feature.

The following letter from Mr. J. E. Gauger, Chief Agriculturist of the Holly Sugar Company, shows, in a few words, how sugar beets grown in the Mesilla Valley compare with those grown in Colorado:—

"Swink, Colo., November 15, 1916.

"Mr. W. B. Mandeville,
Las Cruces, N. M.

Dear Sir:—

Enclosed herewith find list of beet tests of carload of beets just received from there. Wish to congratulate you on tests shown, as they are testing far better than beets in this territory at this time.

Yours truly,
J. E. GAUGER,
Chief Agriculturist."

TABLE 5.—RESULTS AS REPORTED BY SUGAR FACTORY, ON BEETS SHIPPED FROM DONA ANA COUNTY, NEW MEXICO.

Date Received	Locality where Grown, or Car No.	Grower No.	Load No.	Per Cent Tare	Per Cent Sugar in Beets
1916.					
November 14	Mesilla	1	1		16.5
November 14	Mesilla	1	2		14.0
November 14	Mesilla	1	3		15.3
November 14	Mesilla	1	4		15.1
November 14	Mesilla	1	5		16.2
November 14	Mesilla	1	6		13.9
November 14	Mesilla	1	8		15.6
November 14	Mesilla	1	9		13.9
November 14	Mesilla	1	10		17.0
November 14	Mesilla	1	11		14.6
November 14	Las Cruces	2	1		13.2
November 14	Las Cruces	2	2		13.8
November 14	Las Cruces	2	3		13.0
November 14	Las Cruces	2	4		15.7
November 14	Las Cruces	2	5		14.0
November 14	Las Cruces	2	6		13.5
November 14	Las Cruces	2	7		15.5
November 14	Las Cruces	2	8		14.0
November 14	Las Cruces	2	9		14.5
November 14	Las Cruces	2	10		12.5
November 14	Las Cruces	2	11		14.0
November 14	Las Cruces	2	12		15.0
November 14	Las Cruces	2	13		14.7
November 14	Las Cruces	2	13		14.6
November 24	Mesilla Park	3	17	0	14.4
November 24	Brazito	5	1	2	16.7
November 24	Brazito	5	2	1	17.0
November 24	Brazito	5	3	1	15.8
November 24	Brazito	5	4	1	15.1
November 24	Las Cruces	4	2	1	13.7
November 24	Las Cruces	4	10	0	17.1
November 24	Las Cruces	4	11	1	14.5
November 24	Las Cruces	4	13	2	15.6
November 24	Las Cruces	2	1	2	14.7
November 24	Las Cruces	2	2	1	15.0
November 24	Las Cruces	2	4	1	15.5
November 24	Las Cruces	2	8	1	13.5
November 24	Las Cruces	2	10	1	16.5
November 24	Las Cruces	2	12	2	15.2
November 24	Las Cruces	2	14	1	14.2
November 24	Las Cruces	2	15	1	14.8
November 24	Las Cruces	2	16	2	14.6
November 24	Las Cruces	2	17	2	13.6
November 24	Las Cruces	2	18	0	16.5
November 24	Las Cruces	2	19	0	13.8
November 24	Las Cruces	2	20	2	14.0
November 24	——	—	—	2	15.5
November 24	——	—	—	2	14.9
November 25	Mesilla Park	3	16	1	13.6
November 25	Brazito	5	5	1	16.9
November 25	Brazito	5	6	1	15.3
November 25	Las Cruces	4	4	2	14.8
November 25	Las Cruces	4	7	1	16.4
November 25	Las Cruces	4	12	2	14.7
November 25	Las Cruces	2	5	1	12.4
November 25	Las Cruces	2	7	1	13.0
November 25	Las Cruces	2	9	1	14.9
November 25	Las Cruces	2	11	1	15.4
November 25	Las Cruces	2	13	2	15.6
November 25	——	—	—	1	14.5
November 25	——	—	—	1	15.5

TABLE 5.—RESULTS AS REPORTED BY SUGAR FACTORY (Continued).

Date Received	Locality where Grown, or Car No.	Grower No.	Load No.	Per Cent Tare	Per Cent Sugar in
November 29	Las Cruces	4	1		13.5
November 29	Mesilla Park	3	1		16.3
November 29	Mesilla Park	3	2		13.4
November 29	Mesilla Park	3	3		14.4
November 29	Las Cruces	6	1		14.2
November 29	Las Cruces	6	2		14.0
November 29	Las Cruces	6	3		14.5
November 29	Las Cruces	6	4		13.8
November 29	Las Cruces	6	5		15.8
November 29	Las Cruces	7	1		12.9
November 29	Las Cruces	7	2		13.8
November 29	Las Cruces	7	3		13.3
November 29	Las Cruces	7	4		14.1
November 29	Las Cruces	7	5		14.0
November 29	Las Cruces	7	7		12.5
November 29	Las Cruces	7	8		14.1
November 29	Las Cruces	7	9		12.5
November 29	Las Cruces	7	10		13.4
November 29	Las Cruces	7	11		14.8
November 29	Las Cruces	7	12		13.9
November 29	Las Cruces	7	13		14.3
November 29	Las Cruces	7	14		15.0
December 19	82,381				13.4
December 19	82,381				12.8
December 19	82,381				13.2
December 19	82,381				13.0
December 19	82,381				12.2
December 19	82,381				12.5
December 19	82,381				12.4
December 19	82,381				13.9
Average				1.2	14.47

SUMMARY.

1. The results of the experiments indicate that sugar beets with good sugar content and fair purity can be successfully produced in the Mesilla Valley.

2. Sugar beet raising demands a better system of tillage than other crops, which should ultimately increase the fertility and value of the land.

3. Yields varying from 5 to 14½ tons per acre were secured. The yields should increase as the farmers become familiar with proper cultural methods.

4. The results indicate that sandy loam and silt loams are the best types of soil, from the standpoint of tonnage. The soil should be loosened to a greater depth than is usual in ordinary plowing. If this is not done, there is a tendency for the beets to push themselves out of the ground, and poorly formed roots are the result. If the soil is not naturally fertile, well rotted barnyard manure should be applied.

5. Alfalfa sod should be crowned before being plowed very deep.

6. The preliminary work done seems to indicate that in the Mesilla Valley the best date to plant is between April 15 and May 1.

7. The average tare was relatively low on the beets shipped to the factory; attributable, no doubt, to the fact that the soil does not adhere badly to the beets.

8. The proper leveling of the land is one of the most important considerations in the successful growing of sugar beets. Where the land is poorly leveled, the beets will kill out in low spots, on account of too much water; and die out on the high spots for lack of sufficient moisture.

9. Thinning at the proper time is also very important.

10. The Curly Top disease that in some localities proves fatal to many of the beets can, apparently, be combated successfully in southern New Mexico by keeping the beets in a thrifty condition, by proper cultivation, irrigation, etc.

ACKNOWLEDGMENTS.

Acknowledgment is hereby made of assistance received from many sources in the preparation of this bulletin. Much credit is due Dr. L. A. Higley for analyzing beets planted at different dates and for compiling and arranging the analytical data found in Table 4; to Mr. W. B. Mandeville for supplying the data from which Table 5 was made and for reading the manuscript; to Mr. Paul B. Barber for assisting in the collection of sugar beet samples throughout the Mesilla Valley; and to Mr. Phil Erickson for his many helpful suggestions and co-operation along cultural lines.

As mentioned on other pages of the bulletin, several paragraphs were taken from the publications of the United States Department of Agriculture and the Agricultural Department of the Great Western Sugar Company.

Credit is also due the Horticultural Department for co-operation in the growing of some of the beets.

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New Mexico College of Agriculture
And Mechanic Arts

AGRICULTURAL EXPERIMENT STATION
STATE COLLEGE, N. M.

In Co-operation with the United States Department of Agriculture,
Office of Dry Land Agriculture.

The Utilization of Dry Farm Crops in Beef Production

By LUTHER FOSTER and HERBERT G. SMITH

LAS CRUCES CITIZEN

NEW MEXICO AGRICULTURAL EXPERIMENT STATION.

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The Utilization of Dry Farm Crops in Beef Production

INTRODUCTION.

Three experiments have been conducted in cooperation with the Bureau of Plant Industry at the Tucumcari, New Mexico, Field Station, for the purpose of determining to what extent dry-farm crops may be used in feeding range steers for the local markets.

In the dry-farming portions of New Mexico, when conditions are normal or above normal, abundant yields of all adaptable crops, such as milo, kafir, the feed sorghums, cowpeas, etc., may be secured; and during poor years it is usually possible to secure at least small yields of the grain sorghums and fair yields of the feed sorghums, silage crops, and of cowpeas, and in addition to the cultivated lands there is sufficient range to raise more than enough cattle to make use of all the crops that can be raised, either in meat or milk production. The one thing usually lacking is a leguminous crop, which is needed to balance the ration properly for any kind of stock feeding. In order to meet this requirement, the Tucumcari Station has tested several crops, has found that cowpeas are quite a reliable crop under the dry-land conditions of that locality, and a number of the Southern Stations have shown that they give excellent results in feeding; particularly the cowpea hay. Hence, wherever this crop may be grown it will furnish a cheap means of supplying the crude protein needed to balance the ration correctly for cattle feeding, whether it be fed to steers to produce beef for the home markets, to cows for the production of the various dairy products, or used as feed for carrying stock over bad winters; but when found

necessary, cottonseed meal may be substituted for it, but at a greater cost.

These experiments were conducted at the Tucumcari Field Station, and were under immediate charge of the Superintendent. An effort was made to finish only for the local markets. The first of these experiments ran from February 24 to May 10, 1915, a period of 76 days, when the supply of cowpea hay became exhausted, which made it necessary to close the experiment; while the second one ran from February 2 to June 2, 1916, 122 days, which was more nearly the desired length of time of feeding. The length of the third experiment was 105 days, from November 19, 1916, to March 6, 1917, with three days intermission between the first and second periods. During the first period, of 50 days, the steers were on pasture. The time covered by the first experiment was, of course, too short to give the finish that range steers ought to have, even for the local market. However, the steers of all of the experiments were in good condition at the finish and the meat was considered to be of excellent quality by the local butchers. Taking steers off the range in their usual thin condition at the time these experiments began, they ought to be fed at least four months to give them the proper finish; and five months would be better, although under present conditions, four months would, no doubt, result in more profitable gains. Even though the feeding period was limited with the first lot, the results gave a very good indication of what may be expected under similar conditions, and were very favorable to feeding the dry-farm crops at home and returning the manure to the land, rather than selling them at the usual market prices.

While all of the steers that may be produced on the range in the dry-farming localities cannot be fed at home, enough of them can be finished, usually, at least fully to

supply the local markets, and to this extent it should be a profitable undertaking.

In brief, these experiments were intended to determine if crops grown under dry-farming conditions may be successfully used in feeding range steers for beef. With the exception of the cottonseed meal, all the feeds were grown at the Tucumcari Station. One lot of the steers in each experiment was fed entirely on dry-farm crops, depending upon the cowpea hay to furnish the protein necessary for a well balanced ration. The other lots were given shredded kafir stover in 1915 and 1916 and shredded sorghum fodder in 1917, in place of the cowpea hay, as a roughage, and cottonseed meal was given to supply the quantity of protein desired. Both lots of each experiment were given practically the same daily ration of kafir silage, which in the first test amounted to an average of about 25 pounds of silage to 1,000 pounds live weight and in the second to about 20 pounds. During the first period of the third experiment, while the steers were on pasture, they were fed silage at the rate of about 30 pounds per 1,000 pounds live weight, per day. During the second period of this experiment about 40 pounds of silage to 1,000 pounds live weight was fed. Except during the first period of the third experiment, all lots were also given a ration of ground kafir heads. The silage was made of "Early" Black-hulled kafir, stored in a pit silo, and was of excellent quality.

The steers fed were raised on the range in the neighborhood of Tucumcari. Those of the first experiment were coming three-year-olds, those of the second were fall calves, averaging not more than seventeen months old when the feeding was started, while "long yearling" steers were used in the third experiment. In size, quality, form and general condition the steers were below the average of range steers of their ages, but they were in fairly thrifty condition and took to the feed readily,

making fair gains in all the experiments from the start. They had the range instinct and did not become gentle and tractable during the feeding periods. This was particularly true in the first experiment. It is a well known fact that steers that retain their wild range instinct and scare and run from every strange object do not give as good results in feeding as those raised and handled under ordinary farm conditions, and greater care must be taken in protecting them from unusual disturbances or any conditions that tend to excite or make them nervous.

The steers were kept in open corrals protected on the storm side by the wall of a building, hence they were not subjected to the weather conditions of those on the open range.

While in the feeding pens and pasture the steers had water and salt before them at all times. Concentrates and silage were fed in the morning, in all cases, at about 8:00 o'clock. The roughage was fed at about 5:00 P. M. The amounts of each kind of feed fed each pen daily was largely determined by the amount they would eat up without leaving very much waste.

In dividing into lots, special attention was given to individuality, as well as to weight and thrift, so that neither lot would have advantage over the other in any respect. Though this work may be done with great care, points of advantage and disadvantage may appear later that could not well be seen before in the division.

The two lots were weighed on three successive days at the beginning and at the close of each experiment; the averages of the three weighings were taken as the beginning and the closing weights, respectively.

In computing the financial statements the following prices per ton have been allowed for the feeds: Ground milo heads, \$10.00; cottonseed meal or cake, \$35.00; kafir or milo silage, \$3.50; cowpea hay, \$10.00; shredded kafir

stover or fodder, $4.00. It was estimated that it cost about $4.00 a ton to shred the stover or fodder. The other prices used were approximately the farm prices of the feeds mentioned during the fall preceding the beginning of the first experiment. The prices of both feeds and meats have, of course, advanced a great deal during the past three years.

In all of the experiments a small margin between buying and selling prices was allowed. Depending as it does upon the fluctuations of the market, though very important in feeding operations, the margin is very uncertain. However, aside from the improvement in quality, the better the finish of the animal at the time of slaughtering the higher the dressing percentage; and for butchering, allowance should be made for this fact, whether the selling is done locally or in the classified markets.

To give an idea of the approximate cost of producing, on good soil in the vicinity of Tucumcari, the grain, silage and cowpea hay fed in the three experiments, on pages 27 to 32 will be found tables giving cost data. The cost per ton of producing the feeds varies, of course, from year to year and from farm to farm.

The pit silo used in these experiments is 8 feet in diameter and 16 feet deep. The method of construction was as follows: A circular ditch 6 inches wide and having an 8-foot inside diameter was dug 12 inches deep and filled with concrete. The collar extends about a foot above the surface of the ground. After the collar had been made and had set, excavating work was begun. The silo was dug down 10 feet and plastered, and then the other 6 feet were dug and plastered. The cement plaster was placed on the dirt walls. It consisted of one part cement to two parts of good sharp sand. The thickness of the plaster should vary with the type of soil. The silo used

in these tests was in a red clay, and the average thickness of the plaster was 1¼ inch. The total cost of the silo was $56.75, including the cost of labor, cement and all other materials used in its construction. The capacity is about sixteen tons. The proportionate cost of constructing a larger pit silo would, of course, be considerably less.

EXPERIMENT NO. 1.

February 24, 1915, to May 10, 1915; 76 days.

In this initial experiment the conditions were not all wholly satisfactory, but in a way they represented what a farmer may have to contend with in starting a new line of work, such as this. Some of the feeds were quite limited in quantity, which made it necessary to use only a few animals in the experiment and to feed them for a shorter period than is usually desirable.

The steers used were coming three years old, and in size and quality were decidedly below the average of range steers of their age. At the time of year when they were secured (February), practically all the steers of this age had been sold and shipped away, making it necessary to select from cut-backs. Taking into consideration the character and condition of the steers, the time when the experiment was started and the short period it had to run, the prospects were not particularly favorable for good results.

It was the thought that if these experiments, under rather adverse conditions, proved satisfactory, the farmer need not hesitate to undertake a feeding proposition when all conditions are favorable and point to success.

It should be explained that the first two experiments were started so late in the season because of the necessary absence of the Superintendent, who had immediate charge of the work, in connection with other matters relating to the Dry Land Field Station.

FEEDS AND FEEDING.

The silage was made of "Early" Black-hulled kafir, and was stored in a pit silo. It was harvested with a "short corn" row binder, and was hauled up and cut immediately. The kafir was harvested when the grain was in the stiff dough state; at which time the food value is greatest and there is less danger of having silage of poor quality than if cut earlier. The silage was cut into half-inch lengths. In filling the silo a silage distributor was used, such as is illustrated on page 10 of Farmers' Bulletin No. 578 of the U. S. Department of Agriculture, entitled, "The Making and Feeding of Silage." This distributor is a jointed pipe affair, made of heavy galvanized sheet iron. Each joint is about 30 inches in length, and so tapered that the end of one joint will fit loosely into the top of the next lower joint. As the silo is filled, sections of this pipe may be removed. The advantage of the distributor is that instead of having the heavier parts of the plants thrown farthest from the machine while the lighter parts, such as leaves, remain near the machine, all parts of the plant are carried down the distributor and are evenly distributed in the silo. Two men were used in the silo to pack the silage by tramping. A good method of topping the silo is to build a mound of earth over the silage. This forms an effective water- and air-proof roof and brings the contents through in very good condition. The silage used in these experiments kept perfectly and was of excellent quality.

The milo heads contained approximately 78% of grain, which was fully mature before the heads were

harvested. They were ground into a medium fine meal, which the steers ate with relish.

The cowpea hay was harvested when some of the earlier pods were mature. It contained pods in all stages of development. The hay was so carefully handled in curing that it retained its natural color, and practically all the leaves were saved. While the hay might have been classed as coarse, there was very little waste in feeding.

The kafir stover was what was left of the mature plant after the heads were taken off. It was cut as soon as the grain was mature and was cured without bleaching or losing an undue portion of the leaves. Before the feeding started it was run through the shredder and stored in a closed shed. It was sufficiently fine in texture to have the appearance of coarse hay. A much higher percentage of this was rejected by the steers than of the cowpea hay. There was, of course, a larger percentage of woody stem in it, and being cut at a more mature stage of growth, it contained more fiber.

The steers were divided into two equal lots of three steers each. One lot was fed wholly on dry-farm crops, depending upon cowpea hay, a crop not generally grown in the dry-farming districts, to supply the necessary crude protein. The other lot had a ration composed of the ordinary dry-farm crops, milo and kafir, for both grain and roughage, with the addition of cottonseed meal to supply the protein needed to balance it. While the experiment was intended to determine if the dry farmer may use his crops to advantage in beef production, it was likewise a comparison of cottonseed meal and cowpea hay as sources of crude protein. In the beginning both lots were given light rations of grain and silage. These were gradually increased to a full allowance in about thirty days. The average daily rations of the two lots for the full time of the experiment were as follows:—

RATIONS.

Lot I. Ground Milo Heads____9.1 lbs. per head per day
Kafir Silage __________17.4 lbs. per head per day
Cowpea Hay ___________8.6 lbs. per head per day
Lot II. Ground Milo Heads____6.8 lbs. per head per day
Cottonseed Meal________2.3 lbs. per head per day
Kafir Silage __________19.3 lbs. per head per day
Shredded Kafir Stover_11.3 lbs. per head per day

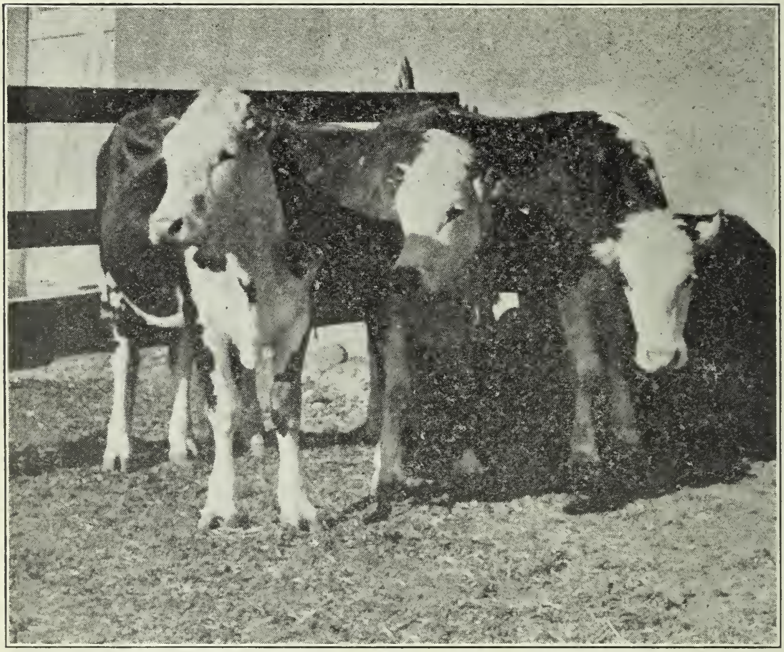
The nutritive ratio of the first ration is 1 to 6.6, and of the second, 1 to 8.4. While these vary a little from the ratios recommended in the feeding standards, they are not far off for growing and fattening steers of the ages of those in the experiment.

Below will be found a record of the gains made by the steers during the progress of the test:—

TABLE I.—WEIGHTS AND GAINS BY PERIODS.

Date	LOT I. Ground Milo Heads, Kafir Silage and Cowpea Hay				LOT II. Ground Milo Heads, Cottonseed Meal, Kafir Silage, and Shredded Kafir Stover.			
	Steer 1. Weight, Lbs.	Steer 2. Weight, Lbs.	Steer 3. Weight, Lbs.	Gain on Lot, Lbs.	Steer 1. Weight, Lbs.	Steer 2. Weight, Lbs.	Steer 3. Weight, Lbs.	Gain on Lot, Lbs.
February 24	598	667	580		708	591	600	
March 9	623	726	652	161	778	620	654	153
March 26	700	782	708	184	830	654	690	122
April 5	696	806	730	42	854	680	722	82
April 20	728	806	746	48	876	694	710	24
May 3	792	892	760	164	930	718	790	158
May 10	800	900	793	49	959	705	781	7
Total gain, 76 days	202	233	213	648	251	114	181	546
Average daily gain	2.66	3.07	2.80	8.53	3.30	1.50	2.38	7.18

It will be noticed from the table that Steer 2 of Lot II proved to be a very poor feeder, making less than half



Lot I at close of Experiment No. 1; fed ground milo heads, kafir silage, and cowpea hay.

as much gain as Steer 1 of the same lot. While the poor showing made by this animal, no doubt, affected the general results somewhat, all of the difference cannot reasonably be attributed to this cause. The ration fed Lot I evidently proved to be appreciably better than that fed Lot II, even during this short feeding experiment.

Additional data are given in Table 2.

TABLE 2.—SHOWING GENERAL RESULTS OF TEST.

	Lot I. Ground Milo Heads, Kafir Silage, and Cowpea Hay	Lot II. Ground Milo Heads. Cottonseed Meal, Kafir Silage, and Shredded Kafir Stover
Initial weight, February 24, lbs.	1845	1899
Average weight per steer, Feb. 24, lbs.	615	633
Final weight, May 10, lbs.	2493	2445
Average weight per steer, May 10, lbs.	831	815
Total gain (3 steers), lbs.	648	546
Average gain per head, lbs.	216	182
Average daily gain per head (76 days), lbs.	2.84	2.393
Ground milo heads fed, lbs.	2080	1560
Cottonseed meal fed, lbs.		520
Silage fed, lbs.	3965	4405
Cowpea hay fed, lbs.	1960	
Shredded kafir stover fed, lbs.		2575
Ground milo heads fed per pound of gain, lbs.	3.21	2.86
Cottonseed meal fed per pound of gain, lb.		.95
Silage fed per pound of gain, lbs.	6.12	8.07
Cowpea hay fed per pound of gain, lbs.	3.02	
Shredded kafir stover fed per pound of gain, lbs.		4.72
Total feed fed per pound of gain, lbs.	12.35	16.60
Feed cost per hundredweight of gain.	$4.19	$5.45

TABLE 3.—FINANCIAL STATEMENT.

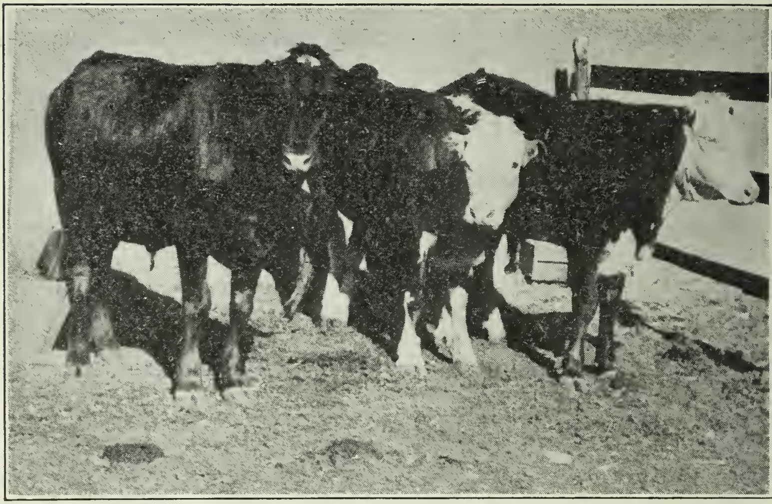
Lot I. Ground Milo Heads, Kafir Silage, and Cowpea Hay.

Value of 3 Steers, weight 2493 lbs., at $8.00 per hundredweight, at close of experiment			$199.44
Value of 3 Steers, weight 1845 lbs., at $7.25 per hundredweight, at beginning of experiment		$133.76	
Value of 2080 lbs. of Ground Milo Heads, at $10.00 per ton	$10.40		
Value of 3965 lbs. of Silage, at $3.50 per ton	6.94		
Value of 1960 lbs. of Cowpea Hay, at $10.00 per ton	9.80	27.14	160.90
Profit on Lot			*$38.54
Profit per Steer			12.85

Lot II. Ground Milo Heads, Cottonseed Meal, Kafir Silage, and Shredded Kafir Stover.

Value of 3 Steers, weight 2445 lbs., at $8.00 per hundredweight, at close of experiment			$195.60
Value of 3 Steers, weight 1899 lbs., at $7.25 per hundredweight, at beginning of experiment		$137.68	
Value of 1560 lbs. of Ground Milo Heads, at $10.00 per ton	$7.80		
Value of 520 lbs. of Cottonseed Meal, at $35.00 per ton	9.10		
Value of 4405 lbs. of Silage, at $3.50 per ton	7.71		
Value of 2575 lbs. of Shredded Kafir Stover, at $4.00 per ton	5.15	29.76	167.44
Profit on Lot			$28.16
Profit per Steer			9.39

*It will be noted that in these statements no charge has been made for labor of feeding and caring for the steers, interest, insurance, salt, rental of equipment, etc., as it is estimated that the value of the manure produced would about cover these items.



Lot II at close of Experiment No. 1; fed ground milo heads, cottonseed meal, kafir silage, and shredded kafir stover.

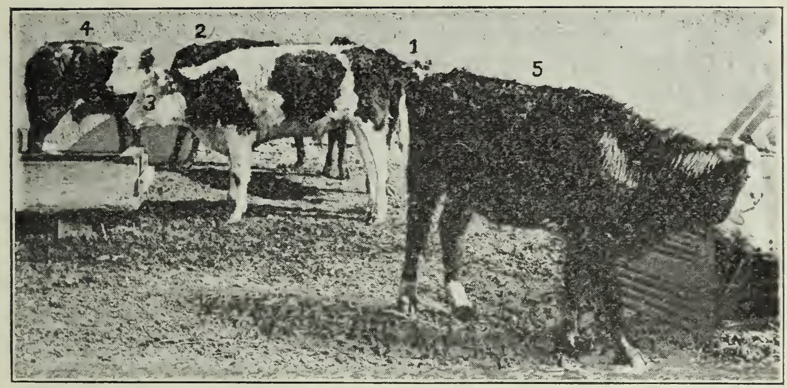
EXPERIMENT NO. 2.

February 2, 1916, to June 2, 1916; 122 days.

The second test was run under practically the same conditions as the first, except that the steers fed were much younger, ranging in age from fifteen to eighteen months; and there were more of them, each lot containing five. The daily rations per head for the period of the experiment averaged as follows:—

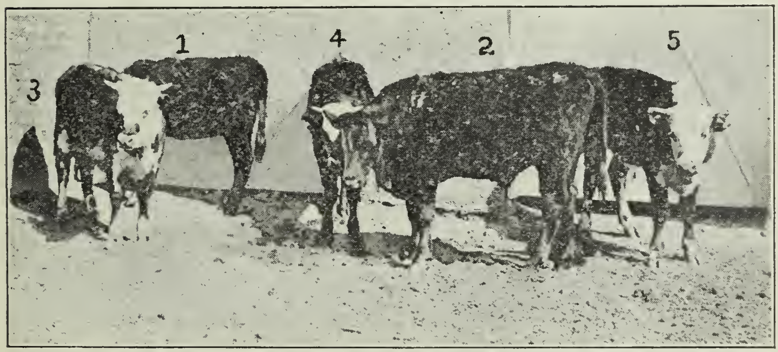
RATIONS.

Lot I.	Ground Milo Heads	7.2 lbs.
	Kafir Silage	11.5 lbs.
	Cowpea Hay	9.3 lbs.
Lot II.	Ground Milo Heads	5.5 lbs.
	Cottonseed Meal	1.6 lbs.
	Kafir Silage	11.9 lbs.
	Shredded Kafir Stover	7.0 lbs.



Lot I at the beginning of Experiment No. 2.

The nutritive ratio of the first ration was 1:5.8; that of the second, 1:8. For growing, fattening steers of this age the first might be considered a little narrow and the second a trifle wide. It is possible that a larger allowance of cottonseed meal, making the ratio narrower, would have brought the gains of Lot II more nearly up to those of Lot I.



Lot II at the beginning of Experiment No. 2.

One steer of Lot II did not prove to be a good feeder, and gained very much less than any other steer in the experiment. His total gain was only 86 pounds, while the average of the other four was 199 pounds. If this poor feeder is omitted, the difference in results between the average weights of the two lots is diminished considerably. However, Table 4 shows that for steers of this age and grade a ration such as fed Lot I is much better than that fed Lot II.

TABLE 4.—WEIGHTS AND GAINS BY PERIODS.

Date	Lot I. Ground Milo Heads, Kafir Silage, and Cowpea Hay		Lot II. Ground Milo Heads, Cottonseed Meal, Kafir Silage, and Shredded Kafir Stover	
	Weight, Lbs.	Gain, Lbs.	Weight, Lbs.	Gain, Lbs.
February 2	2424		2468	
February 16	2594	170	2562	94
March 2	2716	122	2600	38
March 14	2812	96	2678	78
March 29	3010	198	2862	184
April 12	3124	114	3016	154
April 28	3282	158	3106	90
May 10	3410	128	3260	154
May 24	3666	256	3454	194
May 31	3700	34	3376	78 Loss
June 2	3730	30	3372	4 Loss
Total gain, 122 days		1306		904
Average daily gain		10.70		7.41
Average daily gain per head		2.14		1.48

Lot I made a gain 402 pounds greater than Lot II. Table 5 shows that the cost of gain in the case of Lot I was $1.29 per hundredweight less than for Lot II.

TABLE 5.—SHOWING GENERAL RESULTS OF TEST.

	Lot I. Ground Milo Heads, Silage, and Cowpea Hay.	Lot II. Ground Milo Heads, Cottonseed Meal, Silage and Shredded Kafir Stover
Initial weight, February 2, lbs.	2424	2468
Average weight per steer, Feb. 2, lbs.	484.8	493.6
Final weight, June 2, lbs.	3730	3372
Average weight per steer, June 2, lbs.	746	674.4
Total gain (5 steers), lbs.	1306	904
Average gain per head, lbs.	261.2	180.8
Average daily gain per head (122 days), lbs.	2.14	1.48
Ground milo heads fed, lbs.	4373.5	3361.6
Cottonseed meal fed, lbs.		961.2
Silage fed, lbs.	7005	7245
Cowpea hay fed, lbs.	5655	
Shredded kafir stover fed, lbs.		4265
Ground milo heads fed per pound of gain, lbs.	3.35	3.72
Cottonseed meal fed per pound of gain, lbs.		1.06
Silage fed per pound of gain, lbs.	5.36	8.01
Cowpea hay fed per pound of gain, lbs.	4.33	
Shredded kafir stover fed per pound of gain, lbs.		4.72
Total feed fed per pound of gain, lbs.	13.04	17.51
Feed cost per hundredweight of gain.	$4.78	$6.07

The silage used was Early Black-hulled kafir, grown on the Tucumcari Field Station farm and kept in a pit silo. After filling, the silo was capped over with about 3 feet of straw and then about 2 feet of clay put on top of this, to make the silo air- and water-proof. The silage kept in very good condition and practically no spoilage took place at the top of the silo.

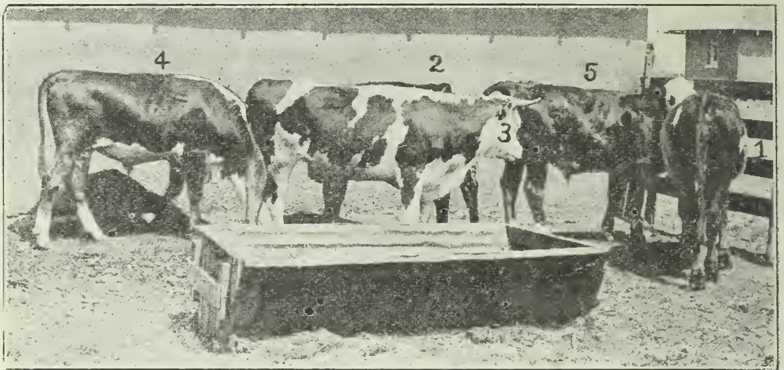
The cowpea hay fed was immature. On August 8, 1915, a hail storm damaged the cowpeas to such an extent that it was thought best to cut them immediately thereafter, to prevent further damage by disease. Practically no pods had formed. Care was exercised in handling the crop after cutting and no spoilage took place.

The shredded stover was Dwarf Black-hulled kafir from which the grain had been threshed. The stalks were run through a shredder and cut up quite fine.

The ground milo heads were very free from stems. All heads were cut without more than 2 inches of stem to each. This crop was headed by hand and the stalks allowed to stand.

During the first 56 days of the experiment, Lot I made a gain of 586 pounds; during the last 66 days, 720 pounds. During the first 56 days, 2.22 pounds of ground milo heads, 5.75 pounds of kafir silage, and 4.72 pounds of cowpea hay were fed per pound of gain. During the last 66 days, 4.26 pounds of ground milo heads, 5.05 pounds of kafir silage, and 4.01 pounds of cowpea hay were fed per pound of gain.

During the first 56 days of the experiment Lot II made a gain of 404 pounds; during the last 66 days, of 500 pounds. During the first 56 days, 2.42 pounds of



Lot I at the close of Experiment No. 2; after having been fed ground milo heads, kafir silage and cowpea hay for 122 days. Note the great improvement in the appearance of the steers.

ground milo heads, .81 pound of cottonseed meal, 9.07 pounds of kafir silage, and 4.57 pounds of shredded kafir stover were fed per pound of gain. During the last 66 days, 4.77 pounds of ground milo heads, 1.27 pound of cottonseed meal, 7.16 pounds of kafir silage, and 4.84 pounds of shredded kafir stover were fed per pound of gain.

TABLE 6.—FINANCIAL STATEMENT.

Lot I. Ground Milo Heads, Kafir Silage, and Cowpea Hay.			
Value of 5 Steers, weight 3730 lbs., at $8.25 per hundredweight, at close of experiment			$307.73
Value of 5 Steers, weight 2424 lbs., at $7.25 per hundredweight, at beginning of experiment		$175.74	
Value of 4373 lbs. of Ground Milo Heads, at $10.00 per ton	$21.87		
Value of 7005 lbs. of Silage, at $3.50 per ton	12.26		
Value of 5655 lbs. of Cowpea Hay, at $10.00 per ton	28.27	62.40	238.14
Profit on Lot			$ 69.59
Profit per Steer			13.92
Lot II. Ground Milo Heads, Cottonseed Meal, Kafir Silage, and Shredded Kafir Stover.			
Value of 5 steers, weight 3372 lbs., at $8.25 per hundredweight, at close of experiment			$278.19
Value of 5 steers, weight 2468 lbs., at $7.25 per hundredweight, at beginning of experiment		$178.93	
Value of 3362 lbs. of Ground Milo Heads, at $10.00 per ton	$16.81		
Value of 961 lbs. of Cottonseed Meal, at $35.00 per ton	16.82		
Value of 7245 lbs. of Silage, at $3.50 per ton	12.68		
Value of 4265 lbs. of Shredded Kafir Stover, at $4.00 per ton	8.53	54.84	233.77
Profit on Lot			$ 44.42
Profit per Steer			8.88

Lot II at the close of Experiment No. 2; after having been fed ground milo heads, cottonseed meal, kafir silage and shredded kafir stover for 122 days.

In a classified market the difference in profit would have been considerably greater than indicated by the above statement. On account of the better finish of the steers of Lot I at the end of the experiment, they would have brought a somewhat higher price than those of Lot II. (See illustrations of the steers at the beginning and close of the experiment.)

EXPERIMENT NO. 3.

First period, November 19, 1916, to January 7, 1917; 50 days.

Second period, January 11, 1917, to March 6, 1917; 55 days.

This experiment was intended to meet the conditions that arose the past season in a large portion of the dry-farming section of New Mexico. Grain crops of all kinds gave very low yields, and yields of forage crops were, as a rule, light. Crops intended for the silo had to be harvested before they were sufficiently mature, in order to save them from destruction by the drouth. The precipitation at the Tucumcari Station during 1916 was only 10.89 inches, being about one-third below normal.

Of this, 1.55, .56, .63, .98, and 4.43 inches fell during April, May, June, July, and August, respectively. The rainfall between April 1 and August 1 was slightly less than half of the normal amount for this period.

A feeding problem was planned to make use of the immature feeds to the best advantage, without the purchase of any outside product, except a small quantity of cottonseed cake to balance the rations properly. It was necessary to use as large a quantity of silage as possible, with a minimum of dry roughage and concentrate. Incidentally, something was learned concerning the feeding value of silage made of immature kafir, which it was found necessary to put into the silo as soon as it was fully headed, in order to save it.

The ten "long yearling" steers used in this experiment were placed in pens at the Tucumcari Field Station on November 16, 1916. They were fed roughage for three days, and were weighed, lumped, on the 16th, 17th and 18th. No record was kept of the feed given or eaten during this three-day period. On November 19 the steers were placed in a pasture on the Station farm, which had not been grazed for about two years. The area of the pasture is approximately 48 acres. They were left in this pasture from November 19, 1916, to January 7, 1917, or a period of 50 days; and during this time were given water and salt at hand, and 25 pounds of cottonseed cake and all the silage, up to 200 pounds, which they would clean up each day. The cake and silage were fed at about 8 A. M.

The gains made by each of the steers are shown in Table 7.

TABLE 7.—INDIVIDUAL WEIGHTS AND GAINS, FIRST PERIOD OF FEEDING TEST.

Date	STEER NUMBER									
	1	2	3	4	5	6	7	8	9	10
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
November 18, 1916..	564	630	692	668	580	632	600	532	560	746
January 10, 1917....	580	692	802	770	662	698	700	596	660	840
Gain (50 days),* lbs.	16	62	110	102	82	66	100	64	100	94
Daily gain, lbs.	.32	.124	2.20	2.04	1.64	1.32	2.00	1.28	2.00	1.88

*As previously noted, the steers were on pasture but 50 days, from November 19 to January 7. It is not probable that any appreciable gain was made between the date of removal from the pasture and the date of weighing. On account of the wildness of the steers, it was not considered advisable to weigh them the usual three times while still on pasture.

Considering the fact that the steers had no feed except 2.5 pounds of cottonseed cake and 19.1 pounds of silage per head per day, the average daily gain made while on pasture was fairly good,—a little better, in fact, than that made by the steers of Lot II, Experiment No. 2, conducted during the early part of 1916. (See Table 5.) The details of the first period of the experiment, and a financial statement, are shown below:—

TABLE 8.—SHOWING GENERAL RESULTS OF FIRST PERIOD OF FEEDING TEST.

Initial weight, November 19, lbs.	6154
Average weight per steer, November 19, lbs.	615.4
Final weight, January 7, lbs.	7007
Average weight per steer, January 7, lbs.	700.7
Total gain (10 steers), lbs.	853
Average gain per head, lbs.	85.3
Average daily gain per head (50 days), lb.	1.71
Cottonseed cake fed, in addition to pasture, lbs.	1250
Cottonseed cake fed per head per day, lbs.	2.5
Cottonseed cake fed per pound of gain, lb.	1.47
Kafir silage fed, in addition to pasture, lbs.	9540
Kafir silage fed per head per day, lbs.	19.1
Kafir silage fed per pound of gain, lbs.	11.18
Total feed fed per pound of gain, lbs.	12.65
Value of feed fed, in addition to pasture	$38.57
Feed cost per hundredweight of gain	$ 4.52

The beginning and closing weights given above are each the average of three weighings, on three different days; while the individual steers were weighed but once at the beginning and close of the first period of Experiment No. 3. On this account, the total gain, Table 8, is not exactly the same as the sum of the individual gains as given in Table 7.

The silage fed during the first period of this experiment was made of "Early" Black-hull kafir, and was put up in a small stave silo.

TABLE 9.—FINANCIAL STATEMENT.

Value of 10 Steers, weight 7007 lbs., at $7.50 per hundred-weight, at close of experiment			$525.53
Value of 10 steers, weight 6154 lbs., at $7.25 per hundred-weight, at beginning of experiment		$446.17	
Value of 1250 lbs. of Cottonseed Cake, at $35.00 per ton..	$21.87		
Value of 9540 lbs. of Kafir Silage, at $3.50 per ton	16.70	38.57	484.74
Increase in value due to pasturing 50 days			$ 40.79
Increase in value per steer			4.08
Value of pasture per acre per month			51

SECOND PERIOD.

After the steers had been taken off pasture and weighed for three successive days they were divided into two lots of five steers each. In making the division an attempt was made to have the two lots as nearly equal in weight and in apparent feeding value as possible.

The daily rations per head for the second period of the experiment averaged as follows:—

RATIONS.

Lot I.	Ground Milo Heads	8.2 lbs.
	Kafir Silage	30.1 lbs.
	Cowpea Hay	6.1 lbs.
Lot II.	Ground Milo Heads	4.9 lbs.
	Cottonseed Cake	2.2 lbs.
	Kafir Silage	31.1 lbs.
	Shredded Sorghum Fodder	5.1 lbs.

The nutritive ratio of the first ration is 1 to 7.5, and of the second, 1 to 7.48.

The results secured are set forth in the following tables:—

TABLE 10.—WEIGHTS AND GAINS BY PERIODS, SECOND PERIOD OF FEEDING TEST.

Date	Lot I. Ground Milo Heads, Kafir Silage and Cowpea Hay						Lot II. Ground Milo Heads, Cottonseed Cake, Kafir Silage, and Shredded Sorghum Fodder					
	Steer 1. Weight, Lbs.	Steer 2. Weight, Lbs.	Steer 4. Weight, Lbs.	Steer 8. Weight, Lbs.	Steer 10. Weight, Lbs.	Gain on Lot, Lbs.	Steer 3. Weight, Lbs.	Steer 5. Weight, Lbs.	Steer 6. Weight, Lbs.	Steer 7. Weight, Lbs.	Steer 9. Weight, Lbs.	Gain on Lot, Lbs.
1917 January 10	580	692	770	596	840		802	662	698	700	660	
February 13	660	758	834	658	924	356	868	738	684*	752	720	240
March 6	709	801	904	683	953	216	893	755	763	779	747	175
Total gain, 55 days	129	109	134	87	113	572	91	93	65	79	87	415
Average daily gain	2.35	1.98	2.44	1.58	2.05	10.40	1.65	1.69	1.18	1.44	1.58	7.55

*February 12th and 13th Steer No. 6 was sick, refusing to eat, and showing symptoms of pneumonia. Was better on February 14, and all right after that date.

From Tables 7 and 10 it will be noticed that although Steer 1 made a very small gain during the first period of the experiment, while on pasture, he proved to be one of the best feeders during the second period.

It will also be observed that the cowpea hay lot again made much the better gain. The feed cost per hundredweight of gain for each lot, and other details, are shown in the following table:—

TABLE 11.—SHOWING GENERAL RESULTS OF SECOND PERIOD OF FEEDING TEST.

	Lot I. Ground Milo Heads, Kafir Silage and Cowpea Hay	Lot II. Ground Milo Heads, Cottonseed Cake, Kafir Silage and Shredded Sorghum Fodder
Initial weight, January 11, lbs	3478	3522
Average weight per steer, Jan. 11, lbs.	696	704
Final weight, March 6, lbs	4050	3937
Average weight per steer, March 6, lbs.	810	787
Total gain (5 steers), lbs.	572	415
Average gain per head, lbs.	114	83
Average daily gain per head (55 days), lbs.	2.07	1.51
Ground milo heads fed, lbs.	2250	1350
Cottonseed cake fed, lbs.		597.5
Silage fed, lbs.	8275	8540
Cowpea hay fed, lbs.	1690	
Shredded sorghum fodder fed, lbs		1414
Ground milo heads fed per pound of gain, lbs.	3.93	3.25
Cottonseed cake fed per pound of gain, lb.		1.44
Silage fed per pound of gain, lbs.	14.47	20.58
Cowpea hay fed per pound of gain, lbs.	2.95	
Shredded sorghum fodder fed per pound of gain, lbs.		3.41
Total feed fed per pound of gain, lbs.	21.35	28.68
Feed cost per hundredweight of gain	$5.98	$8.43

TABLE 12.—FINANCIAL STATEMENT.

Lot 1. Ground Milo Heads, Kafir Silage and Cowpea Hay.

Value of 5 Steers, weight 4050 lbs., at $8.00 per hundredweight, at close of experiment			$324.00
Value of 5 steers, weight 3478 lbs., at $7.50 per hundredweight, at beginning of experiment		$260.85	
Value of 2250 lbs. of Ground Milo Heads, at $10.00 per ton	$11.25		
Value of 8275 lbs. of Silage, at $3.50 per ton	14.48		
Value of 1690 lbs. of Cowpea Hay, at $10.00 per ton	8.45	34.18	295.03
Profit on Lot			$ 28.97
Profit per Steer			5.79

Lot II. Ground Milo Heads, Cottonseed Cake, Kafir Silage and Shredded Sorghum Fodder.

Value of 5 Steers, weight 3937 lbs., at $8.00 per hundredweight, at close of experiment			$314.96
Value of 5 steers, weight 3522 lbs., at $7.50 per hundredweight, at beginning of experiment		$264.15	
Value of 1350 lbs. of Ground Milo Heads, at $10.00 per ton	$ 6.75		
Value of 5975 lbs. of Cottonseed Cake, at $35.00 per ton..	10.46		
Value of 8540 lbs. of Silage, at $3.50 per ton	14.95		
Value of 1414 lbs. of Shredded Sorghum Fodder, at $4.00 per ton	2.83	34.99	299.14
Profit on Lot			$ 15.82
Profit per Steer			3.16

In this experiment if the cowpea hay had been valued at $20.00 a ton, or twice the amount specified in the above statement, the ration fed Lot I would still have been the more economical.

Dressing Weights and Weights of Hides.

All of the steers in Experiment 1 were slaughtered within about three weeks of the close of the experiment. In the case of Experiment 2 there was a little more delay in butchering a few of the steers.

TABLE 13.—DRESSING WEIGHTS AND WEIGHTS OF GREEN HIDES.

Steer No.	Lot	Date Slaughtered	Live Weight, lbs.	Dressed Weight, lbs.	Dressing Percentage	Weight of Hide, lbs.
Experiment No. 1						
1	I	June 2, 1915	848	456	53.8	
2	I	May 20, 1915	922	458	49.7	
3	I	June 2, 1915	786	415	52.8	
1	II	May 20, 1915	950	500	52.6	
2	II	May 27, 1915	744	394	53.0	
3	II	May 27, 1915	896	404	45.1	
Average, Lot I					52.1	
Average, Lot II					50.2	
Difference in favor of Lot I					1.9	
Experiment No. 2.						
1	I	June 15, 1916	649	337	51.9	46
2	I	June 28, 1916	800	416	52.0	60
3	I	July 10, 1916	792	424	53.5	67
4	I	June 6, 1916	778	381	49.0	72
5	I	July 3, 1916	720	392	54.4	58
1	II	June 16, 1916	606	268	44.2	46
2	II	July 12, 1916	872	450	51.6	73
3	II	June 13, 1916	734	372	50.7	64
4	II	June 22, 1916	560	241	43.0	41
5	II	June 26, 1916	692	346	50.0	52
Average, Lot I					52.2	60.6
Average, Lot II					47.9	55.2
Difference in favor of Lot I					4.3	5.4

The table indicates that there was a difference of 11.4% in the percentages of dressed weight between the lowest steer of Lot II and the highest steer of Lot I in Experiment No. 2. The averages in both tests show considerably in favor of the cowpea hay lots.

The following table shows the amounts of the different feeds that were rejected during the three experiments:—

TABLE 14.—FEEDS REJECTED.

	Experiment 1, 76 days		Experiment 2, 122 days		Experiment 3 (second period), 55 days	
	Lot I Lbs.	Lot II Lbs.	Lot I Lbs.	Lot II Lbs.	Lot I Lbs.	Lot II Lbs.
Ground milo heads	0	0	0	79	0	0
Cottonseed meal		0		0		
Cottonseed cake		-				3.5
Kafir silage	124.5	184.75	235.25	0	60.75	67.0
Cowpea hay	196.0		694.25		163.5	
Shredded kafir stover		998.0		1655.75		
Shredded sorghum fodder						484.5

TABLE 15.—SUMMARY OF STEER FEEDING TESTS, 1915, 1916 and 1917.

	Lot I. Cowpea Hay.				Lot II. Cottonseed Meal or Cake.			
	1915, 76 days	1916, 122 days	1917, 55 days	Average	1915, 76 days	1916, 122 days	1917, 55 days	Average
Value of ground milo heads fed	$10.40	$21.87	$11.25		$7.80	$16.81	$6.75	
Value of cottonseed meal or cake fed					9.10	16.82	10.46	
Value of silage fed	6.94	12.26	14.48		7.71	12.68	14.95	
Value of cowpea hay fed	9.80	28.27	8.45					
Value of shredded kafir stover fed					5.15	8.53		
Value of shredded sorghum fodder fed							2.83	
Total cost of feed fed	$27.14	$62.40	$34.18		$29.76	$54.84	$34.99	
Total gain (3 head), lbs.	648				546			
Total gain (5 head), lbs.		1306	572			904	415	
Feed cost per 100 lbs. of gain	$4.19	$4.78	$5.98	$4.98	$5.45	$6.07	$8.43	$6.65
Ground milo heads fed per lb. of gain, lbs.	3.21	3.35	3.93	3.50	2.86	3.72	3.25	3.28
Cottonseed meal or cake fed per lb. of gain, lb.					.95	1.06	1.44	1.15
Silage fed per lb. of gain, lbs.	6.12	5.36	14.47	8.65	8.07	8.01	20.58	12.22
Cowpea hay fed per lb. of gain, lbs.	3.02	4.33	2.95	3.43				
Shredded kafir stover fed per lb. of gain, lbs.					4.72	4.72		3.15
Shredded sorghum fodder fed per lb. of gain, lbs.							3.41	1.14
Total feed fed per lb. of gain, lbs.	12.35	13.04	21.35	15.58	16.60	17.51	28.68	20.93
Dressing percentage	52.1	52.2		52.1	50.2	47.9		49.0

COSTS OF PRODUCING THE GRAIN, SILAGE AND COWPEA HAY FED.

The following tables give the cost of producing and handling the various crops used in the feeding tests. The cost of several of the operations is probably somewhat higher than the expense at which similar operations can be performed on the average New Mexico farm, well equipped with teams and machinery; on account of less expensive labor. However, the figures may be taken as a safe approximation, and will serve as a guide in estimating the cost of producing these particular crops under conditions such as prevail in the dry-farming districts of eastern New Mexico.

TABLE 16.—COSTS OF GROWING, HARVESTING, HAULING, AND GRINDING THE DWARF MILO FED IN EXPERIMENT NO. 1.

Yield per Acre, 1.946 ton of heads. Stalks not cut.
The following are the averages of 17 plats (1-10 acre each) raised during 1914:

Growing the Crop.	Per Acre.	
Fall plowing, 8 inches deep, 1	$1.71*	
Single disking, 1 4-17†, @ 40c	.49	
Single harrowing, 1 1-17, @ 17c	.18	
Cultivation, 13-17, @ 38c	.29	
Seed, 3 lbs., @ 4c	.12	
Planting, with 2-row planter	.38	
Single harrowing, 1 1-17, @ 17c	.18	
Cultivations, 3 5-17, @ 38c	1.25	
Hand hoeings, 2, @ 50c	1.00	
Cost of raising one acre		$6.60
Approximate cost of heading and hauling to stack; per acre		4.62
Approximate cost of hauling crop of one acre from stack in field to feed lots		.99
Cost of grinding the heads, $2.50 per ton; per acre		4.86
Approximate cost of growing, harvesting, hauling, and grinding, per acre		$16.07, or $8.26 per ton.

*In computing the costs of the various operations, $2.00 per eight-hour day was allowed for man labor and $1.00 per eight-hour day for each horse. No allowance was made for rent of land, interest, depreciation, insurance, repairs on equipment, etc.; the figures shown covering only the cost of labor, seed, and twine. Many of the cost data in these tables were taken from Bulletin No. 219 of the United States Department of Agriculture; others were arrived at from work done at the Tucumcari Station.

†Four of the 17 plats were disked twice.

The precipitation at the Tucumcari Field Station during 1914 was 22.24 inches, or 6.03 inches above normal. The precipitation during April, May, June, July and August was 2.52, 5.24, 2.81, 3.90, and 1.06 inches, respectively. Further data concerning climate and crop production at the Field Station may be found in Bulletin No. 104 of the New Mexico Agricultural Experiment Station.

The altitude of Tucumcari is about 4200 feet.

TABLE 17.—COSTS OF GROWING AND PLACING IN SILO OF BLACK-HULL KAFIR USED AS SILAGE IN EXPERIMENT NO. 1.

Yield per Acre, 6,619 lbs.
The amount placed in the silo was 28,257 lbs., or the product of 4.27 acres.

Growing the Crop.	Per Acre.	
Plowing, 1	$1.71	
Harrowings, 3, @ 17c	.51	
Single diskings, 2 @ 40c	.80	
Cultivation, 1	.38	
Seed, 3 lbs., @ 4c	.12	
Planting, with 2-row planter	.38	
Single harrowings, 2, @ 17c	.34	
Cultivation, 1	.38	
Hand hoeing, 1	.50	
Cost of raising one acre		$5.12
Cutting Feed.		
Twine	.25	
Horse and man labor	.50	
Cost of cutting one acre		.75
Cost of hauling crop of one acre from field to silo		1.29
Cost of feeding the ensilage cutter and attending to engine, two men, 5¾ hours each, $2.87; or, per acre		.67
Cost of tramping in silo, two men, 5¾ hours each, $2.87; or, per acre		.67
Total cost of growing, cutting, hauling, and placing in silo, per acre		$8.50, or $2.57 per ton.

TABLE 18.—COSTS OF GROWING, CUTTING, RAKING, SHOCKING, HAULING, AND STACKING THE COWPEA HAY FED IN EXPERIMENT NO. 1.

Yield per Acre, 3,297 lbs. of cured hay.
The following are the averages for eight plats from which the hay was cut.

Growing the Crop.	Per Acre.	
Fall plowing, 1	$1.71	
Single harrowing, 1	.17	
Single disking, 3-8*, @ 40c	.15	
Single cultivation, 1-8, @ 38c	.05	
Seed, 16.5 lbs., @ 5c	.82	
Planting, with 2-row planter	.38	
Cultivations, 3⅜, @ 38c	1.43	
Hand hoeings, 2, @ 50c	1.00	
Cost of raising one acre		$5.71
Approximate cost of cutting, raking and cocking, per acre		3.00
Approximate cost of hauling and stacking, per acre		4.00
Approximate total cost per acre		$12.71, or $7.71 per ton.

Only three of the eight plats were disked.

TABLE 19.—COSTS OF GROWING, HARVESTING, HAULING, AND GRINDING THE MILO FED IN EXPERIMENT NO. 2.

Yield per Acre, 1.298 ton of heads. Stalks not cut, but allowed to stand until the planting season of 1916, to prevent blowing. Without previous preparation, the middles were broken and planted with a lister in May, 1916.

Growing the Crop.	Per Acre.	
Single disking, before plowing, 1	$ .40	
Fall plowing, 8 inches deep, 1	1.71	
Single disking, before seeding, 1	.40	
Seed, 3½ lbs., a 3c	.10	
Planting, with 2-row planter	.38	
Single harrowing, 1	.17	
Cultivation, 1	.38	
Hand hoeing, 1	.50	
Cost of raising one acre		$.4.04
Cost of heading one acre, including hauling to stack; 2 men, 1 team and 1 wagon, 4.1 hours		3.08
Cost of hauling crop of one acre from stack in field to feed lots; 2 men, 1 team and 1 wagon, .88 hour		.66
Approximate cost of grinding heads, $2.50 per ton; per acre		3.25
Total cost of growing, harvesting, hauling and grinding, per acre		$11.03, or $8.50 per ton.

The precipitation at the Tucumcari Field Station during 1915 was 18.13 inches, or 1.92 inch above normal. Of this, 4.00, 1.59, .71, 3.13, and 2.28 inches fell during April, May, June, July, and August, respectively.

TABLE 20.—COSTS OF GROWING AND PLACING IN SILO OF KAFIR USED AS SILAGE IN EXPERIMENT NO. 2.

Yield per Acre, 10,644 lbs.
The amount placed in the silo was 25,440 lbs., or the product of 2.39 acres.

Growing the Crop.	Per Acre.	
Listing in the fall of 1914	$ .60	
Seed	.09	
Planting with lister	.60	
Cultivation, 1	.38	
Hand hoeing, 1	.50	
Cost of raising one acre		$2.17
Cost of cutting one acre with row binder		.75
Cost of hauling crop of one acre from field to silo		2.51
Approximate cost of feeding the ensilage cutter and attending the engine; per acre		1.08
Approximate cost of tramping in silo; per acre		1.08
Total cost of growing, cutting, hauling, and placing in silo, per acre		$7.59, or $1.43 per ton.

Tables 17 and 20 show that the cost per ton of growing the crop and placing in silo was comparatively low, during both 1914 and 1915.

TABLE 21.—COSTS OF GROWING, HARVESTING, HAULING, AND PLACING IN BARN THE COWPEA HAY FED IN EXPERIMENT NO. 2.

*Yield per Acre, 1,490 lbs. of cured hay.

Growing the Crop.	Per Acre.	
Single disking, before plowing, 1	$ .40	
Fall plowing, 8 inches deep, 1	1.71	
Single disking, before planting, 1	.40	
Single harrowing, before planting, 1	.17	
Seed, 16.5 lbs., @ 5c	.82	
Planting with 2-row planter	.38	
Cultivation, 1	.38	
Hand hoeing, 1	.50	
Cost of raising one acre		$4.76
Cost of cutting and raking; 1 man and team 3 hours and 45 minutes; per acre		1.88
Cost of shocking in field, by hand; 2 men 3 hours and 12 minutes; per acre		1.60
Cost of hauling and placing in barn; 2 men, wagon and team, 1 hour and 54 minutes; per acre		1.42
Total cost per acre		$9.66, or $12.97 per ton.

*The yield was reduced materially by a hail storm that occurred on August 8, 1915. This, of course, made the cost per ton of producing the cowpea hay considerably higher than it otherwise would have been.

TABLE 22.—COSTS OF GROWING, HARVESTING, HAULING, AND GRINDING THE MILO FED IN THE SECOND PERIOD OF EXPERIMENT NO. 3.

Yield per Acre, .289 ton of heads. Stalks not cut.

Grown on land without preparation. Planted May 12, 1916, by breaking the middles of previous year's milo ground and planting at the same time, with lister.

Growing the Crop.	Per Acre.	
Seed, 3 lbs., @ 4c	$ .12	
Planting with lister	.60	
Cultivations, 3, @ 38c	1.14	
Cost of raising one acre		$1.86
Approximate cost of heading one acre, including hauling to stack		.69
Approximate cost of hauling the crop of one acre from stack in field to feed lots		.15
Cost of grinding the heads, $2.50 per ton; per acre		.72
Approximate cost of growing, heading, hauling, and grinding, per acre		$3.42, or $11.83 per ton.

TABLE 23.—COSTS OF GROWING AND PLACING IN SILO OF KAFIR USED AS SILAGE IN EXPERIMENT NO. 3.

Grown on land listed in the fall of 1915; 5.6 acres being planted to "Early" Black-hull kafir and 7.7 acres to Dwarf Black-hull kafir.
Yields: from the "Early" Black-hull kafir, 4,499 pounds per acre; from the Dwarf Black-hull kafir, 2,682 pounds per acre.

"Early" Black-hull Kafir—		
Cost of Growing.	Per Acre.	
Single disking, 1	$ .40	
Listing in the fall of 1915	.60	
Seed, 3 lbs., @ 4c	.12	
Planting with lister	.60	
Cultivations, 3, @ 38c	1.14	
Cost of raising one acre		$2.86
Cost of cutting with row binder, per acre		.98
Cost of hauling crop of one acre from field to silo		1.19
Cost of feeding the ensilage cutter, attending engine, and tramping in silo; per acre		1.14
Cost of growing, cutting, hauling, and placing "Early" Black-hull kafir in silo; per acre		$6.17, or $2.74 per ton.
Dwarf Black-hull Kafir—		
Cost of Growing.		
Listing in the fall of 1915	$ .60	
Seed, 3 lbs., @ 4c	.12	
Planting with lister	.60	
Cultivations, 3, @ 38c	1.14	
Cost of raising one acre		$2.46
Cost of cutting with row binder, per acre		.98
Cost of hauling crop of one acre from field to silo		.71
Cost of feeding the ensilage cutter, attending engine, and tramping in silo; per acre		.68
Cost of growing, cutting, hauling, and placing Dwarf Black-hull kafir in silo; per acre		$4.83, or $3.60 per ton.

Owing to the comparatively small yield of green feed that is usually secured from the Dwarf Black-hull kafir, it is not recommended as a silage crop. It was used in this instance on account of there not being enough of the "Early" Black-hull kafir to fill the two silos and provide sufficient silage for the feeding test. The unusually dry weather in the early part of the season reduced the yields very materially.

The pit silo used was covered with straw and earth, and there was no spoilage. Some spoilage occurred in a small stave silo that was also filled in 1916.

TABLE 24.—COSTS OF GROWING, HARVESTING, HAULING, AND STACKING THE COWPEA HAY FED IN THE SECOND PERIOD OF EXPERIMENT NO. 3.

Yield per Acre, 3,794 lbs. of cured hay.

The following are the averages for ten plats from which the hay was cut; eight of the plats being plowed 8 inches deep in the fall of 1915 and two plowed 6 inches deep during the spring of 1916.

Growing the Crop.	Per Acre.	
Plowing, 1	$1.71	
Single disking before planting, 1	.40	
Cultivation before planting, 3-10, @ 38c	.11	
Seed, 16 lbs., @ 5c	.80	
Planting, with 2-row planter equipped with furrow openers	.38	
Cultivations after planting, 2 6-10, @ 38c	.99	
Hand hoeing, 9-10, @ 50c	.45	
Cost of raising one acre		$4.84
Cost of cutting and raking, per acre		2.50
Cost of shocking in field, by hand, per acre		3.00
Approximate cost of hauling and stacking, per acre		4.60
Total cost per acre		$14.94, or $7.88 per ton.

Considering the light rainfall until late in the season, it will be noted that the yield of cowpea hay secured in 1916 was very good, with a fairly low cost of production. On account of being very drouth resistant, the cowpeas were in fair condition to utilize to the best advantage the moisture furnished by the abundant rains that fell during August, 1916. This was much better for the peas than if they had had very good conditions early in the season and had then been subjected to a drouthy period later. The variety used was the Whippoorwill.

Tables 16 to 24 indicate that the approximate costs of the milo heads, kafir silage, and cowpea hay, delivered at the feed lots, averaged as follows for the three feeding experiments that were conducted: Milo heads, $7.03 per ton; kafir silage, $2.39 per ton; cowpea hay, $9.52 per ton. To the cost of the milo heads as fed should be added $2.50 per ton for grinding; making the ground heads cost approximately $9.53 per ton.

SUMMARY.

1. The average results of the three experiments show that all the feeds necessary for fattening range steers for beef, on a properly balanced ration, may be grown under dry-farming conditions, and that the feeding may be more economically done by using cowpea hay instead of the commonly used cottonseed meal or cake.

2. The total gain of the cowpea hay lots for the three tests was 35% greater than that of the cottonseed meal lots. The average cost per 100 pounds of gain for the former was $4.98, and for the latter, $6.65; a difference of $1.67 per hundredweight, or 33%, in favor of the cowpea hay.

3. The quantity of feed required for 100 pounds of gain was markedly favorable to the cowpea hay lots, which, taking an average of the three tests, made 100 pounds of gain from 1558 pounds of feed; while the cottonseed meal lots required 2093 pounds,—a difference of 34%.

4. The results strongly emphasize the superior value of cowpea hay as a roughage for fattening steers; and by inference, for feeding other stock. It supplies the crude protein necessary to make balanced rations, in connection with other dry-farm crops, such as the grain and feed sorghums, obviating the purchase of cottonseed meal or other high-priced concentrates for that purpose. It takes the place of alfalfa in dry farming.

5. The immature kafir silage used in Experiment 3 gave satisfactory results. While it contained less dry matter than the more mature, it was probably more digestible. The steers relished it more than the mature, as indicated by the larger ration eaten.

6. The results of the first part of Experiment 3 indicate that it might prove profitable to hold native pasture for late fall and early winter feeding. Considering the small ration the steers had in addition to the pasture, they made very satisfactory gains. With a larger grain ration and a little longer feeding period they would have made good beef for the local market, economically produced.

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New Mexico College of Agriculture and Mechanic Arts

Agricultural Experiment Station
State College, N. M.

WHEAT

By Rupert L. Stewart

New Mexico Agricultural Experiment Station

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WHEAT

CONTENTS

INTRODUCTION

Wheat raising in New Mexico contributes quite largely to the agriculture of the State. A crop survey was made in most of the counties some time ago, and from these figures it is estimated that there were considerably over two million bushels of wheat produced in the State the past season. This crop is adapted to a large portion of the State. In some sections of the dry farming districts wheat is the principal cash crop, and in practically all irrigated sections it is used as one of the main crops in the rotation. The purpose of this bulletin is to describe the methods of growing wheat in both the irrigated and dry farming sections, and to report some field trials of varieties and cultural method tests which have been conducted at the Experiment Station during the past few years.

PREPARING THE SEED BED

Seed-bed preparation includes the plowing, harrowing, rolling, etc., in other words, fitting the land preparatory to planting. It is just as essential to have a good seed bed for wheat as for any other crop. There are several ways of preparing a good seed-bed, depending somewhat on the previous crop, character of the soil and method of supplying moisture.

Wheat is a shallow-rooted plant, and when it is to be seeded

after a cultivated crop the soil can usually be prepared for seeding by the use of a disc and ordinary harrow. Considerable time and money can be saved by this method, but if weeds are plentiful plowing will probably be necessary. When wheat follows other than a cultivated crop, the seed-bed should be prepared by plowing 6 or 7 inches deep several weeks before seeding. It should be harrowed at once and worked down with a disc. This gives the soil time to settle, thus making it better suited for wheat. This crop does best when a firm seed-bed with a fine, mellow surface to a depth of 2 to 3 inches is made.

Fall plowing for spring wheat is usually preferable to spring plowing, except in rare cases where heavy winds cause the soil to blow. In many cases this can be remedied by leaving the land rough through the winter months.

SELECTING THE SEED

Low yields are often due to the use of poor seed. The use of good seed pays. Grading the seed with a fanning mill will do more to maintain yields than the introduction of new seed. Broken, immature, shriveled grains, weed seeds and all foreign material should be removed by fanning and grading the seed before it is sown. Only plump, well-filled grain should be sown. Use as nearly pure seed as possible. Mixtures ripen unevenly. Wheat does not run out if properly selected and graded from year to year.

TREATING SEED FOR SMUT

The most common disease of wheat in New Mexico is the smut. This disease can largely be controlled by treating the seed. There are two kinds of smut that attack wheat, viz., loose smut and stinking smut or bunt. These two smuts can be distinguished easily, since the stinking smut has a disagreeable odor which can be recognized in the threshed grain. The loose smut attacks both the chaff and the kernels, and the heads are destroyed, nothing remaining of the affected head but the rachis, or central stem. In stinking smut the grain only is affected. The chaff is seldom if ever destroyed, so that close inspection is necessary to distinguish smutted from healthy heads. The smutted grains are larger and more irregular, and when broken are found to contain a compact mass of dark brown spores. These spores are distributed in the threshing and handling of the seed, and, adhering to the grain, are planted with it, and germinate with it. The fungus then penetrates the young plant somewhere below he surface of the soil and grows along with it to bloom-

ing time, when it invades the young grain and develops and matures its masses of spores. The loss from loose smut in New Mexico is but slight, but thousands of dollars are annually lost by stinking smut. This disease can be controlled by treating the seed before planting. The cheapest, easiest and safest treatment is what is known as the "Formalin Treatment," and is as follows: Blow out with a fanning mill, or by some other means, as many of the smut balls as possible; then mix one pint (16 oz.) of 40 per cent. formaldehyde with 45 gallons of water. Put this solution in a barrel and immerse a sack containing about one-half bushel of grain in this and allow the grain to soak 10 minutes or so. Then spread the grain out to dry. Another method is to sprinkle the mixture of formaldehyde and water over the grain spread several inches thick on a clean floor or canvas, stirring until every kernel is thoroughly wet. Then cover with sacks or blankets and allow to stand several hours. It is important to have the formaldehyde solution of proper strength, as if too weak it will not kill the spores, and if too strong it will injure the grain. Be sure he formaldehyde is 40 per cent. in strength. Wash out the drill with the solution, and do not put the treated grain in sacks that held the untreated wheat, unless the sacks have been wet with the solution. An increase of half a peck to a peck to the acre should be made if seed swollen from smut treatment is used.

RATE OF SEEDING

The rate of seeding depends upon the condition of the seed bed, the fertility of the soil, moisture available, time and method of seeding. A poorly prepared seed bed requires more seed per acre, for some of the seed will not be sufficiently well covered to germinate; others will germinate and then die for lack of a suitable place to send their roots. On a well-prepared seed-bed every sound grain should germinate and grow. A fertile soil will support more plants per acre, but will also supply enough plant food so that each kernel that germinates will produce a head of grain. Under irrigation sufficient moisture can almost always be supplied, but under dry farming this is an influecning factor in the rate of seeding. Where there is plenty of moisture available, heavier seeding can be practiced than where moisture is scant.

When seeding is so late that there is but little time left for fall growth, more seed should be sown per acre. When the drill is used in seeding the wheat, less seed per acre is required than where it is broadcast by hand.

In the irrigated districts of the State, 60 to 90 pounds per acre

are usually sown, depending on the above mentioned factors. In the dry farming sections, 35 to 50 pounds per acre are usually sown.

TIME OF SEEDING

The time of seeding wheat will vary with the locality and climate, but, barring all factors other than soil and climate,, the best results are obtained with winter wheat when it is sown early enough for the plants to stool and become established before the cold weather sets in. In the higher altitudes of the State the early plantings are the best. From August 15 to October 15 is usually the best time to plant in these localities, but in the lower and warmer sections of New Mexico good results have been secured when the planting has been done as late as December 15.

Spring sown grain should be planted early, February 1 to March 1 being the best time to plant spring wheat in the lower altitudes, but it can be planted somewhat later in the higher altitudes.

METHOD OF SEEDING

There is no question of the superiority of drilling over broadcasting wheat. The drill insures a more uniform depth of covering of the seed and therefore a more uniform germination and stand, and requires less seed per acre than when broadcast. In the dry farming sections drilling is doubly preferable, because the furrows tend to hold the snow, thus insuring more moisture, and the drill leaves the surface uneven, which keeps the soil from blowing so badly. Under ordinary conditions the depth of planting should be about 2 inches, but on loose soils where the moisture is deeper it is necessary to plant 3 or 4 inches deep. Four inches is probably the maximum depth at which wheat should be planted.

IRRIGATION

In many parts of the State the precipitation is not sufficient to mature a crop of wheat, and it is necessary to irrigate to supply the necessary moisture. There are two methods that are followed in supplying moisture for germination, viz., irrigating the land before or after seeding. By the former method the seed is planted in a dry seed-bed and then irrigated. This method is called "irrigating up." By the other method the land is irrigated and the seed planted in the moist soil as soon as t is dry enough for a team to walk on the land without bogging. The latter method is probably the better except in rare instances, since irrigation after seeding has a tendency to cement the soil and a crust is formed, making it hard for

the young plants to get through. This may be partially remedied by harrowing the ground as soon as possible after irrigation.

WHEN TO IRRIGATE

There are several things that must be taken into consideration in determining the time of irrigating and the total amount of water that must be applied to the wheat plant in order to mature a good crop. The character of the soil and the climatic conditions have a large influence on the water requirement, and each farmer must largely determine these for himself. However, he should bear in mind that there are two critical periods in the development of the wheat plant. The first extends from germination until the plant shades the ground. The second is at the flowering or fruitage stage. The plant must get a good start in order to insure a good harvest. Sufficient food is present in the parent kernel to start root growth and to force the first leaves into view, but from then on it must shift for itself. If moisture is scare at this stage, the necessary food cannot be obtained, and a stunted growth is the result. If too much moisture is present, the plant is likely to turn yellow and be permanently injured. A stunted wheat plant is just like a stunted pig,--it will never entirely overcome the setback. More moisture is required at the flowering or fruitage stage and immediately following than at any other stage of growth. To avoid checking the growth, plenty of moisture should be applied about booting time, before the heads appear, and if the ground does not hold moisture well and as a result the plant has a shallow root system, it would be advisable to irrigate again when the grain is in the dough. Grain which has plenty of moisture is of a light green color, but when the plant begins to suffer for water it turns to a dark green, and the lower leaves begin to turn yellow.

HARVESTING

Wheat is ready to harvest when it is in the "hard dough" state; that is, when the grain can be slightly dented when pinched between the fingers. Grain harvested earlier than this will shrivel, and if left until dead ripe most varieties will shatter badly. Wheat is ready to cut when nearly all the straw has become yellow.

A large percentage of the grain in New Mexico is cut with the binder and threshed directly from the shock, or stacked and then threshed. Where a threshing machine can be obtained soon after harvest, shock threshing is preferred, as it requires less labor than stacking and then threshing. The combined harvester and thresher is not used to any extent in this State.

VARIETY TEST AT THE EXPERIMENT STATION

Variety tests of wheat have been carried on at the Station for a number of years, and several hundred varieties of wheat have been grown from time to time. Bullein No. 4 contains the results of such work up to and including 1911.

In the spring of 1912 three head selections were made of each of the varieties of wheat then on hand at the Station—forty-four in all. Special apparatus for threshing and cleaning, so as to avoid mixing, was provided. These were harvested by hand as they ripened, and were placed in the shade and allowed to become properly cured before threshing.

The pure seed that was selected in this way was used the following spring in planting rod rows, 844 being planted. The work was carried on in duplicate, so that about six rows of each variety were planted, every tenth row being a check. In this way inequalities of the soil were reckoned with. These were given good care. They were cultivated with a garden hoe when the plants were small, and weeds were hoed out from time to time. Practically all varieties grew well. The varieties were harvested by hand, as they ripened, carried to the seed rooms, and after drying a few days, were carefully threshed. . The yields were exceptionally high, as is shown in table 1.

It will be noticed from the table that some of the varieties gave yields much higher than the average for the State; but it must be remembered that they received better than the average care. They were planted in rod rows about 12 inches apart, and were cultivated by hand after each irrigation, until the plants shaded the ground.

TABLE 1.—VARIETY TEST OF WHEAT, 1913.

Variety	Yield in Bushels per Acre
Sonora	75.68
Lohi	73.92
Bola Blanca	67.76
Hedgerow	66.88
Kehl	65.56
Propo	60.28
Cape	60.28
Purple	59.40
Rodi	57.64
Blount's No. 16	56.22
Archer's Prolific	54.12
Algerian	52.80
Kalo	51.92
New Zealand	49.72
Sitley's Golden	49.72
Early Java	48.84
Ruby	47.96
Muiray	47.96
Kubanka	47.52
Galgalos	47.08
Defiance	47.08
Vt. Wards	46.64
Regenerated Defiance	46.20
Canadian Wonder	46.20
Wash. Blue Stem	46.20
Macaroni	45.76
Taganroy	44.44
Longberry	43.12
Alaska	42.68
Paros	42.24
Yellow Gharnovka	42.24
Minnesota 163	40.92
Arnantka	40.92
Little Club	40.04
Polish	38.28
Russian Red	36.16
Blue Stem	35.59
Medeah	34.79
Powers Fife	32.56
Odessa No. 4	29.92
Sask. Fife	29.04
Frates	26.40

TABLE 2.—VARIETY TEST OF WHEAT, 1917.

Variety	Yield in Bushels per Acre
Early Baart	41.78
Canadian Wonder	38.22
Marquis	35.55
Little Club	35.11
Sitley's Golden	34.78
Longberry	34.33
Purple	33.55
Propo	32.66
Muiray	31.44
Alaska	30.67
Wash. Blue Stem	30.44
New Zealand	30.11
Red Russian	30.00
Rodi	28.17
Yellow Gharnovka	27.56
Archer's Prolific	27.33
Bola Blanca	27.33
Minnesota 163	27.33
Kalo	26.67
Kubanka	26.55
Paros	26.44
Defiance	25.67
Hedgerow	25.66
Arnantka	24.67
Sonora	23.67
Taganroy	23.56
Ruby	23.56
Cape	23.45
Lohi	22.89
Algerian	22.00
Odessa No. 4	21.33
Medeah	21.33
Regenerated Defiance	21.11
Power's Fife	20.33
Early Java	20.33
Macaroni	20.00
Saskatchewan Fife	14.22

In 1917 thirty-seven varieties of wheat were planted in fortieth-acre plots. The feld was laid out in three series and three plots of each variety were planted, one in each series. All plote were planted about the same date and all given the same number of irrigations and the same general care. Table 2 gives the results of this test.

Although the 1917 yields were not so high as those in the previous table, they were, on the whole, very good, and the wheat was grown under field conditions. Early Baart gave the highest yield this year, but cannot be compared with the other years because it was recently introduced into this section.

The wheat was planted on January 31, February 1, 2 and 3, and then irrigated to cause germination.

The plots were harvested by hand as soon as they ripened. The date of ripening varied from July 2 to July 15. Sonora and Marquis were about the earliest.

COMPARATIVE TEST OF FALL SOWN EARLY BAART AND SONORO WHEATS

On November 4, 1915, two half-acre plots were seeded to Early Baart and Sonora wheat. The seed of the Early Baart variety was grown in Arizona and secured through the W. D. Wise Seed Company of El Paso, Texas. So far as the writer knows, this was the first seed of this variety sown in this Valley. (A description of this variety will be found on page 28. The millers report good milling tests from this wheat.

The Sonora wheat has been grown for many years in this Valley; and although not so well suited to making flour, it yields well and is quite easy. This variety is also described on page 28.

These varieties were planted on November 4 at the rate of 90 pounds per acre. The Sonora was harvested on June 7 and yielded at the rate of 39.26 bushels per acre. The Early Baart was harvested on June 15 and yielded at the rate of 41.69 bushels per acre—2.46 bushels per acre better than the Sonora, but was eight days later in ripening.

DATE OF PLANTING AND RATE OF SEEDING TEST

Several experiments have been conducted at the Station in an effort to determine the best date to plant wheat. In 1913 an experiment was begun with the object of studying the effect of time of planting on yield, time of harvest and relation of grain to straw.

In all sixty-three plots were planted to Rodi wheat, which is well adapted to this part of the country. (A description of this varety will be found on page 28. The plots were approximately one-tenth acre in size. Six plantings of three plots each were made, commencing October 1, 1913, and planting approximately every thirty days thereafter up to and including March 2, 1914. The seed grain was recleaned and treated for smut, the entire lot being prepared for seeding at the beginning of the experiment. The summary of this work will be found in the following table:

TABLE 3—AVERAGE YIELDS UNDER DIFFERENT DATES OF PLANTING AND DIFFERENT RATES OF SEEDING

Date of Panting	Rate of Planting	Date of Harvesting	Yield per Acre	Per Cent Straw
1913	Pounds	1914	Bushels	
Oct. 1	60	June 8	12.93	67
Oct. 1	90	June 8	13.31	64
Oct. 1	120	June 8	15.67	63
Nov. 1	60	June 8	22.99	60
Nov. 1	90	June 8	18.02	59
Nov. 1	120	June 8	22.01	59
Dec. 2	60	June 6	26.25	61
Dec. 2	90	June 6	27.97	59
Dec. 2	120	June 6	23.77	61
1914				
Jan. 1	60	June 20	15.89	63
Jan. 1	90	June 20	17.47	61
Jan. 1	120	June 20	14.24	61
Jan. 31	60	June 20	18.53	62
Jan. 31	90	June 20	15.52	63
Jan. 31	120	June 20	15.91	62
Mar. 2	60	June 23	9.92	76
Mar. 2	90	June 23	7.84	73
Mar. 2	120	June 23	9.02	80

In the averaging of the yields in the preceding table, taking the plantings of October 1, November 1, December 2, January 1, January 31 and March 2, we find that the highest average was given by the plats in which the grain was planted at the rate of 60 pounds per acre, while the 90 and 120-pound plantings gave practically the same average; as is shown by the following:

Planting at the rate of 60 pounds per acre averaged 17.72 bushels.

Planting at the rate of 90 pounds per acre averaged 16.68 bushels.

Planting at the rate of 120 pounds per acre averaged 16.77 bushels.

Figure 1:-View of 1917 experimental plots

Averaging them with respect to time of planting, the December 2 planting gives the highest average, as shown below:

Plantings of October 1, 1913, averaged 13.97 bushels.

Plantings of November 1, 1913, averaged 21.01 bushels.

Plantings of December 2, 1913, averaged 25.99 bushels.

Plantings of January 1, 1914, averaged 15.87 bushels.

Plantings of January 31, 1914, averaged 16.35 bushels.

Plantings of March 2, 1914, averaged 9.16 bushels.

Averaging them with regard to date of planting and the rate of seed sown gives the highest average for the December 2 planting at the rate of 90 pounds of seed per acre, as shown by the following

OCTOBER 1, 1913.

Planting at the rate of 60 pounds per acre, average 12.93 bushels.

Planting at the rate of 90 pounds per acre, average 13.31 bushels.

Planting at the rate of 120 pounds per acre, average 15.67 bushels.

NOVEMBER 1, 1913.

Planting at the rate of 60 pounds per acre, average 22.99 bushles.

Planting at the rate of 90 pounds per acre, average 18.02 bushels.

Planting at the rate of 120 pounds per acre, average 22.01 bushels.

DECEMBER 2, 1913.

Planting at the rate of 60 pounds per acre, average 26.25 bushels.

Planting at the rate of 90 pounds per acre, average 27.97 bushels.

Planting at the rate of 120 pounds per acre, average 23.77 bushels.

JANUARY 1, 1914.

Planting at the rate of 60 pounds per acre, average 15.89 bushels.

Planting at the rate of 90 pounds per acre, average 17.47 bushels.

Planting at the rate of 120 pounds per acre, average 14.24 bushels.

JANUARY 31, 1914.

Planting at the rate of 60 pounds per acre, average 18.53 bushels.

Planting at the rate of 90 pounds per acre, average 16.24 bushels.

Planting at the rate of 120 pounds per acre, average 15.91 bushels.

MARCH 2, 1914.

Planting at the rate of 60 pounds per acre, average 9.92 bushels.

Planting at the rate of 90 pounds per acre, average 8.25 bushels.

Planting at the rate of 120 pounds per acre, average 9.02 bushels.

Plat No. 29, planted on December 2, 1913, at the rate of 90 pounds of seed to the acre, gave the highest yield: 32.7 bushels to the acre; while No. 28, planted at the same time and at the rate of 60 pounds of seed per acre, was a close second with a yield of 32.16 bushels per acre. From the results of the experiment it might be concluded that the December planting is the best; and while sowing at the rate of 90 pounds of seed per acre gave the highest yield, the planting at the rate of 60 pounds per acre is more economical and

probably more advantageous for fall or early winter seeding.

All of the results would have been much better had it not been for the fact that a hail storm just before harvesting did considerable damage and reduced the yields very materially.

The following articles were prepared by the county agricultural agents in several of the principal wheat-producing counties of New Mexico:

CHAVES COUNTY

Introduction. Up to the present time wheat growing has been given but little attention in this County. The average acreage devoted to this crop for the last four years will not exceed three hundred acres; and it has been grown principally to reclaim worn-out alfalfa soil or as a nurse crop with alfalfa.

It is not because the soil and climate of this County are unsuited to the raising of wheat, for where it has been given proper care and attention very good yields have been obtained. It is probably due to the fact that heretofore very satisfactory returns have been obtained from raising alfalfa on an extensive basis and the farmers have acquired the habit of producing hay or fruit exclusively.

This one-crop system is beginning to affect the soil, and smaller yields of hay are the result. The need, then, is to put in other crops, and wheat will fit in well as a rotation crop. Considerable interest is now being taken by the farmers in wheat and rye, as permanent crops for this County, and it is reasonable to expect a marked increase in the acreage of the small grains from now on.

Varieties. Turkey Red is the principal variety grown, and seems to be very well adapted to this locality. Experimental plots will be carried on with the 1918 crop, to determine, if possible, the best variety from all standpoints for this County.

Preparation of Seed Bed. Not enough attention is given to preparing the seed bed, and if profitable yields are to be expected more time and energy must be given to this important phase of the work. When wheat follows alfalfa, or is put on new land, the ground is plowed to a depth of four or five inches and harrowed once. When the soil is particularly heavy it may be disked before the harrow is put on. In some cases where old alfalfa has just been plowed and harrowed before seeding, the alfalfa roots send up new plants the following year, and a crop of alfalfa seed is harvested after the wheat is taken off. Considerable wheat will be sown in the corn stubble this year after the ground is disked.

The seed bed is usually well irrigated before planting. The ground should be worked more after it is plowed, till the seed is sown If it is harrowed and disked repeatedly, weeds will be eradicated to a large extent, and moisture will be conserved.

Date of Planting. The average date of fall planting is about October 15. Wheat has been seeded as late as November 25, but much better results are obtained when it is put in earlier. The winter of 1916-17 was rather severe, and some of the grain which had made a fairly good growth was frozen entirely.

Pasturing. It has been the practice to pasture the crop during the winter months with dairy cows and calves, and in many cases several head have been brought through the winter without other feeds. Where the pasturing has not been too severe, it has been found that just as good a yield was obtained, and it seemed to be helpful in checking the "Green Bug" (grain aphis), which does a great deal of damage here.

Method of Seeding. A grain drill is used in most cases to plant the crop. Some,however, sow broadcast and harrow it in.

Rate of Seeding. From a bushel to a bushel and three pecks of seed is sown to the acre. The latter amount gives the best results, and is planted probably three inches deep.

Date Harvested. Harvest takes place about June 15 to July 1. Grain planted early in September would probably be ready for harvest early in June. This gives ample time for planting and harvesting a crop of cane or even a crop of Pinto beans on the same ground. Very few have taken advantage of this opportunity, however, and allow the land to be idle for the remainder of the season.

Yield per Acre. As high yields as 30 to 40 bushels to the acre have been obtained on a few places in the county. This was due to the care and good farming methods used in producing the crop, such as thorough preparation of the seed bed, good seed, and sufficient moisture. The average yield will not exceed 17 bushels.

Smut Losses. About five per cent. of the grain in the County each year is lost by the presence of stinking smut. This is a waste that can be avoided easily and cheaply, by treatment of the grain. Only 25 per cent. of those raising wheat make a practice of treating the seed. *All seed should be treated.*

Conclusion. The production of winter wheat in this County is bound to be taken up on a much larger scale in the future than it has in the past. It works well with almost any rotation system, and particularly with the growing of alfalfa, corn and fruit.

When water for irrigation is scarce, as it is in some parts of Chaves County, winter wheat is especially suitable, since the water can be used on it in the fall, winter and early spring, and by the time the spring sown crops need watering the wheat is far enough along so that it will mature without further irrigation. Two crops can be obtained from the same piece of land; which means higher efficiency.

R. R. Robinson,
Agricultural Agent.

CURRY COUNTY

History. The early settlers of New Mexico considered the land fit only for grazing purposes. Finally a few of the more adventurous settlers planted crops of the grain sorghums, with more or less success. Curry County had to go through all the stages of evolution common to a new country. After it had been demonstrated that with proper cultural methods drouth resistant row crops could be raised, some attention was given to wheat raising. Through the faith and courage of such men as Mr. Fred W. James, Mr. G. W. Jones, and others, wheat raising has been brought to the front until this is now the leading single crop to be grown in the County.

About 35,000 acres of wheat were harvested in 1917, producing 281,000 bushels. The largest yields have been produced from summer fallowed land, 30 bushels being produced this year, while last year, one field produced 40 bushels per acre. The fallow system has not been thoroughly tried out in this County, and for this reason its adoption on a wholesale plan cannot be recommended. However, there are many records very favorable to it. The average yield previous to 1916, on land not fallowed, was estimated at 15 bushels per acre. However, the 1916-17 yield, due to the drouth, has been placed at 8 bushels per acre.

General Conditions. The elevation in Curry County ranges from 4200 to 4500 feet. The average rainfall is about 20 inches, the heaviest precipitation falling during the early fall and the spring months. During the winter, some snow generally offers a slight protection to the crop and gives additional moisture. Winter killing by freezing and heaving is practically unheard of, although during extremely dry years some fields have been injured by blowing, particularly in the lighter soils. The cool nights during the late spring and summer present ideal growing conditions, causing the crop to mature slowly. The greatest drawback to the wheat farmer is the high winds, but when proper cultural methods are practiced and the proper soil for wheat raising has been selected, no serious losses follow. The tighter soils are best adapted to this crop, as the lighter soils are likely to blow in the spring and fall, cutting and burning the plants, and in some instances blowing the wheat from the ground. Natural vegetation may be relied upon as a guide in selecting soils suitable for wheat. The absence of bear grass and high bunch grass, and the presence of a fine, short turf, is characteristic of the tighter lands.

Preparation of the Land. This is one of the most important operations in the whole system of dry-farming, and this is especially true in wheat raising; for after the wheat has been planted, there

is no system of culture that will correct the mistakes made before sowing.

Land should be plowed or double listed before it is planted to wheat. The depth of plowing depends upon the time the work is done. The soil should not be stirred too deeply just before planting, as this gives a very loose seed bed, which is unfavorable to the young plant. Just before planting, 5 inches is generally deep enough for plowing. When land is to be summer fallowed, or it is to lie out for several months, it may be plowed six to ten inches deep.

On wheat stubble, it has been found a good practice to double disc as soon as the wheat is removed. This will form a mulch to hold whatever moisture is in the soil, and also places it in shape to take in all rain that falls before the plowing is done. The plow or lister should begin operations as soon as moisture conditions will permit. The disc, with the blades set almost straight, should follow the plow. Land that is plowed in the morning should be disked before noon, and land plowed after noon should be disked before night. While the disc harrow is one of the best instruments used in the preparation of the seed bed, it should not be relied upon to perform the entire operation.The disc cannot take the place of the plow or lister. Many farmers who have depended upon the disc for their entire seed bed preparation, are finding their soils becoming depleted of available plant food and vegetable matter, and each year finds the crop more scant, and the weeds more abundant. The kind of soil, moisture conditions, and season of the year will determine, to a large extent, just how much tillage should be given before seeding. Some farmers have had good results from planting wheat in the rows with corn, kafir, maize, etc., but it may generally be said that such practice cannot be advocated. Where the crop is free from weeds, and there is a large supply of moisture in the soil, fair results may be expected; but land planted in this way generally makes the low yields.

Seed. Seed selection for wheat planting receives less attention than for any other crop. It is generally thought that as long as wheat contains no seeds of weeds, or other foreignmatter, it is good enough for planting; yet there is but little wheat produced anywhere that does not need to be recleaned before planting. Cleaning and grading will take out the chaff, and the cracked, shrunken, and immature grains that always fail to produce strong, healthy plants, even when they germinate. An improvement of the quality of the grain produced in Curry County may be expected in the future, due to the fact that fanning mills are being used , and more people are cleaning their seed than ever before.

Turkey Red is the variety grown almost exclusively in this region, and is well adapted to the soil and climatic conditions.

Planting. It is a general practisce to plant the wheat during the month of September. This seems to give the most satisfactory results, though good crops have been produced from both earlier and later plantings. However, since nearly all the winter wheat is pastured, September plantings seem advisable, as this gives the crop a chance to get well rooted before the stock is turned in, and growth is checked by the cold weather.

Press drills of the different kinds are used in planting. From 30 to 40 pounds of seed is planted per acre, although 30 pounds per acre gives best results when sown early. Later sowings require more seed, as the crop does not have a chance to stool well before cold weather checks its growth.

The seed is generally planted from two to three inches deep, depending on the moisture conditions, it being advisable to plant in moist soil, unles the moisture is too deep. However, rather than resort to very deep planting, it has been found more satisfactory to plant in dry soil and wait for the fall rains to bring up the crop.

E. Peterson, Agricultural Agent,
Curry County.

EDDY COUNTY

For a number of years a small acreage of wheat has been grown in this County. In 1916 there were 889 acres of wheat harvested and 1350 acres in 1917. Estimates on the acreage that will be plant-e dfor the 1918 crop are around 4000 acres. From these fgures it can readily be seen that the wheat crop in Eddy County is relatively small. Wheat, like all other crops in this County, is grown under irrigation. Ordinarily the growing of wheat and other small grains on high priced irrigated lands is not profitable. However, there are reasons, even under normal conditions, why a small grain crop should be grown on high priced irrigated lands. For example, wheat can be included very nicely in a rotation; (2) as a nurse crop for alfalfa it pays the expense of preparing the ground; (3) in fields badly infested with weeds, fall planted wheat helps to smother out and partly, sometimes wholly, eradicate the same; (4) it affords a fairly good pasture during the winter months.

The abnormal conditions that exist at this time, which are responsible for the increased demand and the accompanying high prices paid for wheat, have had a very stimulating effect upon the wheat acreage to be sown this fall (1917).

Because of the fact that whatever wheat is grown in this County must be grown under irrigation, and because there is such a variety of other crops grown that are equally as profitable, and in the majority of cases, more so, there is not much room for wheat acreage expansion in this County. There are great opportunities, however, for a wonderful increase in the yield per acre.

Meteorological Data. The average annual rainfall in Eddy County is approximately 14 inches. Most of the precipitation occurs in the form of torrential rains, which makes its distribution uncertain and unreliable, so far as aiding in crop production is concerned. The following table shows the distribution during the past ten years:

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1906	0.67	0.68	0.20	3.46	0.49	0.92	6.89	1.32	1.37	0.45	3.43	0.98	**20.86**
1907	0.10	0.00	T	0.05	0.34	1.46	1.71	2.81	T	8.08	1.22	0.05	**15.82**
1908	0.33	T	0.38	0.68	T	1.69	7.20	1.98	0.95	T	0.37	T	**13.58**
1909	0.05	T	0.04	0.00	0.02	0.57	3.66	1.67	1.00	0.19	0.38	0.50	**8.08**
1910	0.09	0.00	0.04	0.12	0.20	0.02	0.91	1.55	0.48	0.34	0.12	0.08	**3.95**
1911	**0.54**	1.82	**0.50**	0.75	1.35	1.01	5.97	1.23	1.16	0.33	0.20	0.96	**16.82**
1912	0.00	0.45	0.30	0.55	0.19	2.72	0.93	1.93	3.18	0.77	0.85	0.82	**12.68**
1913	0.18	0.28	0.97	1.33	0.14	3.93	0.70	0.84	3.93	1.03	1.21	0.79	**15.33**
1914	0.70	0.20	0.30	0.67	1.08	3.74	4.73	0.46	1.38	1.95	1.24	3.22	**19.04**
1915	0.44	0.80	2.15	5.04	0.28	1.36	1.14	1.26	5.40	0.12	0.00	0.58	**18.57**
1916	0.30	0.12	0.10	1.34	0.06	T	5.63	6.83	0.30	4.52	0.55	0.12	**19.87**
Avg	**0.27**	**0.41**	**0.18**	**1.12**	**0.39**	1.14	4.13	1.86	1.11	1.58	0.92	0.52	**.13.80**

A study of the above table shows very clearly that our rainfall is too irregular to depend upon for crop production, year after year.

Varieties. The variety of wheat most commonly grown is the Turkey Red. This is a bearded red winter wheat. It tillers well, stands the winters, affords pasture from early fall to late spring, and produces a grain of excellent milling qualities. This variety can be handled at harvest time with but little loss from shattering, which is a very commendable feature.

The Kharkov variety, which is almost identical with the Turkey Red, but supposedly a hardier strain, has been tried out in the County and has been found to do about the same as Turkey Red.

A soft, white beardless strain known locally as May Wheat, yields about the same as Turkey Red. This wheat is probably the Sonora variety, a soft spring wheat. Under our conditions any of the spring varieties can be planted in the fall.

As stated elsewhere, an important work to be done in this County

is in yields rather than in increased acreage. The yields of wheat have not been satisfactory. There is too great a variation. This factor reflects somewhat upon the individual farmer and his methods of farming, while also soil variations have considerable influence. The Spring Grain Aphis, or Green Bug, and Stinking Smut, have materially decreased the yields in some instances. For example, there have been reported authentic yields as high as 42 bushels per acre. On the Carlsbad reclamation project, where most of the wheat of the County is grown, the average yields for 1915, 1916 and 1917, were 23, 16 and 17 bushels, respectively.

In order to increase the yields per acre, more attention must be paid to the preparation of the seed bed; the time and depth of planting, the selection and treatment of seed, etc.

Preparation of the Seed Bed. As practically all of the wheat in this County is planted in the fall, the plowing should be done in July or August, if possible. This plowing should be deep. When Johnson grass is present in the field it is better to allow the ground to become thoroughly dried out and then plowed dry about three inches deep. The harrow should follow the plow to pull out the Johnson grass roots that were cut in plowing. The field should be left in this condition until the exposed roots are thoroughly dried out and dead. Then the field can be irrigated and plowed a second time to a depth of six to eight inches. The land should then be double disked, harrowed and floated or dragged. In conection with plowing many farmers have found that it is better to plow the land dry and then irrigate This is not always an easy operation, but where the land is irrigated before plowing, so much of the soil moisture is lost before planting that it is difficult to get a good stand. Old alfalfa land is very desirable for wheat. To eradicate the alfalfa thoroughly, it is necessary first to crown the alfalfa. This is done by plowing about 2 1-2 to 3 inches deep. The crowns are then harrowed out and allowed to dry up. A second plowing follows two or three weeks later, which is about six to eight inches deep. Subsequent treatment of this soil should be the same as described above. Land that was in small grain should be plowed six to eight inches deep as soon as the former crop is removed. If this land is not too dry it is better to plow without irrigating. This should be followed with a disc and allowed to remain in that condition until time of planting. At planting time the ground should be irrigated, double disked, harrowed and dragged. Where it is desired to plant wheat after barley or oats, and there is considerable shattered grain on the ground, another method is followed to prevent the latter from mixing with the wheat. This method is to irrigate the stubble and then disk lightly and follow with the harrow. This will cause

the shattered grain to germinate and grow. When this volunteer crop is three or four inches high, and all the shattered grain supposedly germinated, the land can then be plowed about six inches deep, with the same subsequent treatment as described above.

Some practice the planting of wheat in standing corn. Considering the cost of preparing the ground, and the fact that a second crop can be secured from that land, this practice is economical and should be encouraged.

Some of the methods of preparing the seed bed as described above seem to call for too much labor or operations that are not essential. The difference between these methods and slip-shod methods is responsible for the widely varying yields that have been obtained in this County. The most successful farmers realize that a good seed bed and a good stand of wheat are prerequisites for bigger and more profitable yields. These methods have been studied and worked out within the County, and are thoroughly recommended for the County.

Time, Depth and Method of Planting. Experience in wheat growing under conditions in this County have clearly demonstrated that the best time to plant wheat is from about August 25 to Oc. 15. Not much wheat is planted as early as August 25, excepting when used as a nurse crop for alfalfa. Of course, the early planting will make a god growth before cold weather, and the farmer should plan to pasture it down.

Practically all of the wheat is planted with a grain drill, from 1 1-2 to 2 1-2 inches deep. The depth of planting depends upon how much surface mulch there is, and in any event, the seed should be planted deep enough to come in contact with the moist soil. This insures germination and a good stand. Fall sown grain should never be sown broadcast. If the seed bed is not firm it is advisable to follow the planter with a corrugated roller. This brings the moisture in contact with the seed.

Amount of Seed Required. About four pecks of wheat are sown to the acre when planted early. For late October, November and December plantings from 5 to 6 pecks are required. These amounts are for irrigated conditions only.

Seed Selection. Very often low yields are caused by the use of an inferior strain of seed. The simple operation of fanning the seed wheat will result in a material increase in yield. By fanning, all the small shriveled and broken grains are removed, leaving only the plump seed.

The farmer can also go into his wheat field just before harvest time and select the more desirable heads. It is only necessary

to select a few pounds from the field. These heads can be hand-threshed and planted on the very best soil. In a couple of years he will have enough good seed from the few heads selected to plant his entire areage.

Enemies. The wheat crop has the following enemies that cause poor yields in many cases:

The *Spring Grain Aphis* or *Green Bug* is the only insect that interferes with the wheat crop in this County. Our mild winters seem to be very suitable for the development of this pest. The damage varies, depending upon the climatic conditions. With our mild winters, however, a goodly number of the Green Bugs can be expected each year. Some years they appear in the latter part of January, while in others they do no apparent damage until as late as May. Many farmers irrigate their fields as soon as they find them infested with the Green Bug. This practice does not appear to check the damage for more than a day or so, but rather seems to make conditions more favorable for their development. Close grazing of the field with sheep or cattle seems to check the ravages of this pest more than any other method. Warm weather is also very detrimental to the grain aphis, while they thrive without difficulty, apparently, when the thermometer registers around the zero mark. There is a parasite that helps in some years to keep down the numbers of the aphides. The plowing under of the volunteer crop in the fall of the year is a control measure that is being used to some extent by the farmers of the County. This practice is not in as general use as it should be.

Stinking Smut has been quite prevalent in wheat in this County until the last year or so. By means of demonstrations on the treatment of seed wheat with the formalin solution for smut, the grower has ben convinced that this plant disease can be controlled, and this year practically all of the wheat planted has been treated for smut. Formalin (40 per cent. formaldehyde) has been used at the rate of one pint to 40 gallons of water. Sprinkling the wheat with this solution is the method used.

Conclusions. Wheat raising in this County will be limited, because it must be grown under irrigation. It s a very important crop, and is needed in our system of farming, since it is a good cash crop, and fits well into crop rotation.

J. W. Knorr,
County Agricultural Agent.

SAN MIGUEL COUNTY

Altitude. The altitude at which spring and winter wheat is grown in San Miguel County is from 5000 to 9000 feet, or an average of 6000 feet. Most of the wheat grown in the low lands is under irrigation. In the mountain valleys wheat is grown with the natural precipitation.

Rainfall. We have a rainfall in San Miguel County ranging from 12 inches in the lowlands to 25 inches in the mountain regions, and the several varieties of wheat seem to do just as well in the lowlands as in the uplands, as long as there is sufficient moisture.

Dry Farming. We have a very peculiar condition in this County regarding what we term dry farming, and "Temporal." or crops grown with the natural precipitation. Dry farming has reference to the crops grown with an average rainfall of not more than 16 inches, while under "Temporal" conditions, crops are grown without irrigation, bpt with a precipitation of from 20 to 28 inches.

Date of Planting. The date of planting of spring wheat in the County varies with the altitude, but we can safely say that wheat should be planted as the land thaws. These dates in San Miguel County are from the first of March to the first of May. Winter wheat is planted from the 15th of August to the 10th of October.

Varieties. Three years ago we had not less than 15 varieties of spring wheat in San Miguel County; no one knew which variety was the best and there was much confusion. Through a campaign to ascertain the better varieties, and thus standardize our crops, we have succeeded in establishing three important varieties of spring wheat, and one variety of winter wheat. Defiance is perhaps the best soft spring wheat we have, except that it is quite susceptible to rust and smut. The Marquis is the best spring hard wheat, of splendid milling qualities, somewhat smut and rust resistant, and very early maturing. It is also one of the most drouth resistant varieties we have. The other spring wheat is bearded, has a very large head, and the kernel is very plump. The native people call it Candial. They have planted this wheat from times immemorial. They do not know where it came from, but in studying carefully we are led to believe that it is one of the Canadian wheats. The winter variety of wheat is the Turkey Red. Several varieties have been tried, but the Turkey Red seems to be superior in every way.

Seeding. (a) Winter wheat, under dry farming conditions, is planted at the rate of from 15 to 35 pounds to the acre, depending on the nature of the soil and the farmer who is planting it. Under "temporal" conditions we figure on planting almost double this

amount. The reason for this is that under such conditions there is an abundance of moisture to mature the heavier crop. Under irrigation, where the crop can be irrigated, whenever it needs it, we always plan on planting from 50 to 80 pounds of winter wheat to the acre.

(b). Spring wheat is planted at the rate of 40 to 90 pounds to the acre, always varying the amount of wheat with the precipitation in the locality in which it is planted.

Depth of Seeding. The best results have been obtained by planting the wheat from 3 to 5 inches deep, where the soils are sandy; it always being best to plant the wheat deep. It has been demonstrated numerous times that deep planted wheat does better than when planted otherwise, unless it happens to be a very rainy season, when shallow planted wheat will do equally well, but to "play safe" the planting should be done deeply.

Seed Bed. Perhaps volumes could be written on the preparation of a good seed bed, but for our purpose it will be sufficient to state how our farmers prepare the seed bed for the small grains. For spring planting we prefer to plow in the fall and leave the ground open. Very early in the spring the land is disked shallow, the disc being followed by the tooth harrow and then the drag. The ground is then ready for planting with the drill. If the land cannot be plowed in the fall, the only safe way would be to plow early in the spring, using the same implements as above mentioned. If too late in the spring, plow shallow and disk, which is practiced with success if the season happens to be rainy. The preparation of the seed bed for winter wheat is the same, except the plowing starts as soon as the other crops are harvested, unless the land is summer fallowed.

Pasture. (a) Spring wheat is never pastured in San Miguel County. (b). Winter wheat has been pastured in the fall and for a short time in the spring, with success. There are quite a number of farmers who have made the mistake of pasturing the wheat too long in the spring, and consequently light crops have been harvested.

Yields. (a) Spring wheat in San Miguel County, under irrigation, yields from 30 to 45 bushels per acre, under average conditions. Under dry farming it yields from 10 to 25 bushels per acre, and average about 12 bushels per acre.

(b) Most of the winter wheat is grown under dry farming conditions, and it yields from 8 to 25 bushels per acre, or an average of about 12 bushels per acre. Under irrigation winter wheat yields from 20 to 25 bushels per acre.

Harvest. Most of the wheat in this County is harvested with

a binder, and the threshing done with a threshing machine. In a very few districts they are harvesting the wheat with a header. The dates of harvesting spring wheat are usually from July 1 to September 20. Winter wheat is harvested from June 15 to August 14.

Smut. In the fall of 1914, 90 per cent. of the wheat raised in San Miguel County was affected with smut. There were but very few farmers who treated the wheat before planting, but through a vigorous campaign in the eradication of the smut, made by the County Agent, the business men interested in the growing of this crop, and the co-operation of the flour mills of Las Vegas, we have succeeded in reducing the loss of wheat by smut, and are assured by farmers who raise wheat and by the mills that buy the same, that at this time only about 20 per cent. of the wheat farms are affected by smut. This year, particularly, the wheat crop is very free from this disease.

M. R. Gonzalez,
County Agriculturist

UNION COUNTY

Wheat growing in Union County is confined largely to the higher elevations and to the western half of the County. The elevation in that part of the County varies from 5,500 to 7,000 feet. The soil is generally of the heavier type, and the winter and spring precipitation much heavier than in the eastern half of the County.

Winter wheat is more generally grown, and with the exception of a small area in the Grande valley and around Des Moines, very little spring wheat is grown. Turkey Red is the most popular variety of winter wheat grown, while the durums or macaroni are the most popular spring varieties.

Most of the wheat is seeded on corn, sorghum and bean land. This land is either plowed or listed for these crops, and cultivated through the summer, to kill weeds and hold the moisture. The wheat is planted in this ground without any further preparation in many cases, while in others the land is disked before planting.

Sometimes wheat is followed by wheat, and in this case the land is plowed shallow or double disked as soon as the previous crop is harvested. It is then worked down into a firm seed bed and planted either in the fall or spring. If planted to spring wheat it is left rough through the winter.

Nearly all the wheat is planted with drills, though a small percentage is seeded broadcast. A drill with press attachment is best

for this County. From 30 to 40 pounds of winter wheat is seeded to the acre, and from 45 to 60 pounds of spring wheat. The winter wheat is planted two inches deep, and the spring wheat 2 1-2 inches deep.

The planting season for winter wheat extends over a long period, from August 1 to December 1. Most of the wheat, however, is planted in September. Spring wheat is planted from April 15 to June 1. The best season for planting spring wheat is from May 20 to June 1. None of the spring wheat is pastured, but the early seeded winter wheat is pastured in the fall and spring.

The harvest season extends from July 20 to August 25 for winter wheat, and from September 1 to October 1 for spring wheat. Most of it is harvested with headers, although the binder is used to quite an extent.

In some sections smut is very bad, and probably 10 per cent. of the crop is lost from smut. The winter grains seem to be more apt to smut than the spring wheats, although both are liable to have smut. About 50 per cent. of the farmers now treat their seed for smut, and this disease is fast being controlled.

One of the popular methods of preparing wheat land is to break sod land early in the spring and cultivate it through the summer, to make a seed bed and to keep the weeds down. It is then seeded to winter wheat in September or October.

Spring wheat, with the exception of the Durums or Macaroni wheat, has been very little grown in Union County, but there are several factors which indicate that some of the spring varieties may be better adapted to this County than winter wheat. The long, dry, windy winter and spring is very hard on winter wheat, and large acreages are blown out and killed each year before the rainy season sets in. Spring wheat planted the last of May on a well prepared seed bed escapes the dry, windy weather, and makes its growth during the rainy season. Some new varieties planted on May 20 and May 28, 1917, withstood the dry, unfavorable season, and still made a very creditable showing, outyielding the Durum or Macaroni wheat in the same section.

Orren Beaty,
County Agriculturist.

DESCRIPTION OF VARIETIES

Figure No. 2 shows a typical spike of 5 different types of wheat that have been grown at the Station for several years. Figure No. 3 shows the kernels from these spikes. A short description of these varieties follows:

No. 1 .Rodi.

A bearded spring wheat with light yellow chaff or glumes, and a medium long, hard, red kernel. Spike, or head, medium long and medium open. Straw stiff. Seed does not shatter. Matures late.

No. 2. Marquis.

A beardless spring wheat with hairless white or greenish-white chaff or glumes, and a short, hard, red kernel. Spike, or head, is short and open. Straw stiff. Seed does not shatter badly, and matures early.

No. 3. Early Baart.

A bearded spring wheat with light yellow chaff or glumes, and a long, medium hard, amber-colored kernel. Spike, or head, long, medium open. Straw stiff. Seed does not shatter badly. Matures moderately early.

No. 4. Sonora.

A beardless spring wheat with light yellow chaff or glumes, and a medium long, soft, white kernel. Spike, or head, medium long, compact. Straw stiff. Seed does not shatter badly. Matures very early.

No. 5. Hedgerow.

A beardless spring wheat with light yellow chaff or glumes, and a short, soft white kernel. Spike, or head, clubbed, medium short and compact. Straw stiff. Seed does not shatter badly. Matures moderately early.

Figure 2:-Typical heads of wheat grown at the New Mexico AgriculturalExperiment Station. (Original.) 1, Rodi; 2, Marquis; 3, Early Baart, 4,Sonora; 5, Hedgerow.

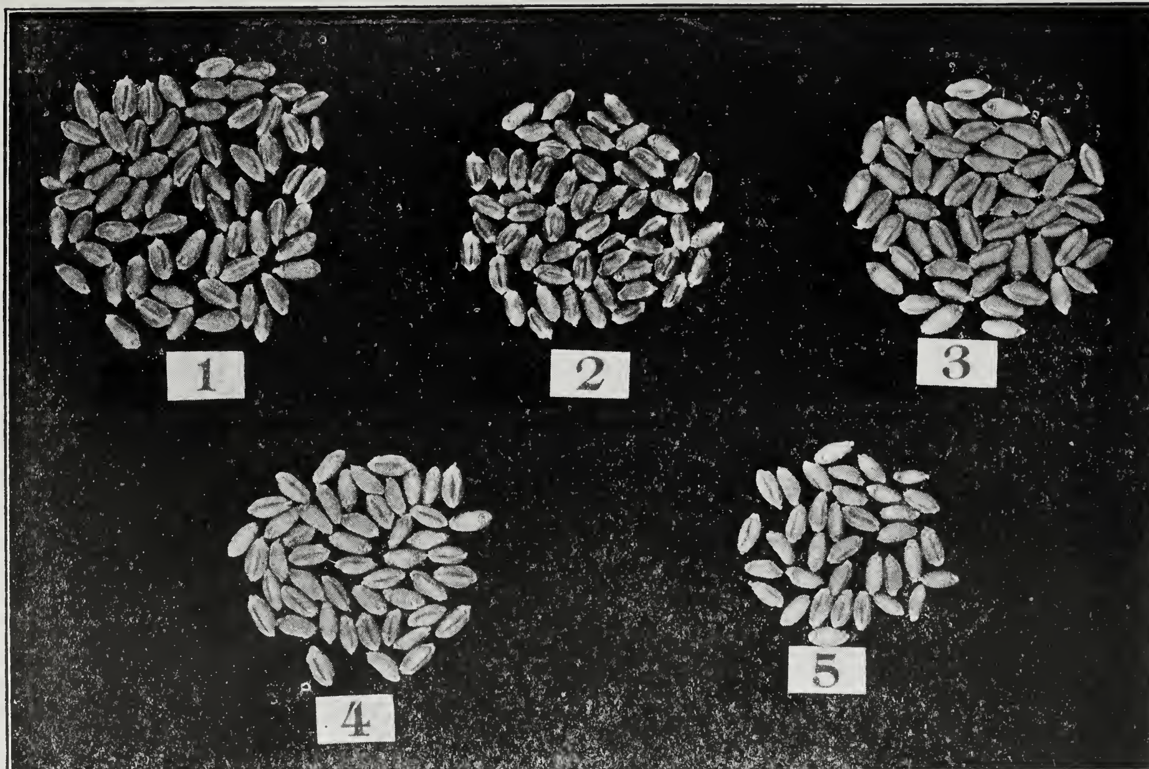

Figure 3:-Grain from heads shown in Figure 2. (Original)

CONCLUSIONS

1. Prepare a good seed bed; plant good seed, with a drill.

2. Treat the seed with a 40 per cent. formaldehyde solution to control smut.

3. Don't seed too heavily; sixty to ninety pounds of seed per acre under irrigation, and 30 to 50 pounds under dry farming, should be sufficient. Slightly more seed per acre should be sown in the spring than if planted in the fall or early winter.

4. The experiments show that some varieties ripen very much earlier than others. This is an important consideraton when a crop is to follow wheat the same season.

5. In most places in the State so-called spring wheat can be sown in the fall with good success.

6. Fall sown wheat usually ripens a week or ten days earlier than the same variety spring sown.

7. The Early Baart and Marquis are two very promising varieties that have recently been introduced into New Mexico.

ACKNOWLEDGMENTS

Credit for a large part of the investigational work upon which this bulletin is based should be given Dr. E. P. Humbert, who was in charge of the work during the years 1912 to 1915; to Mr. Fernando Quintero, who assisted in conducting the experiment tabulated in Table 3; and to the various assistants in the department who aided in carrying on the work.

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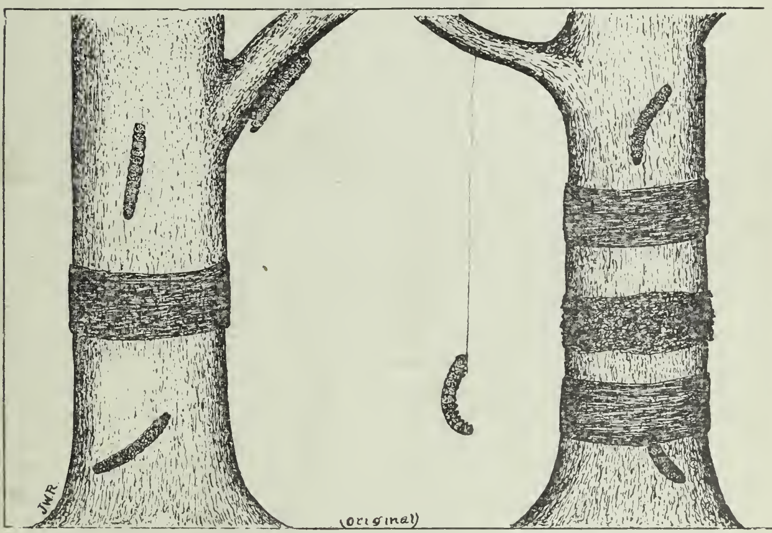
AGRICULTURAL EXPERIMENT STATION

STATE COLLEGE, N. M.



METHODS OF BANDING TREES TO CAPTURE CODLING MOTH LARVAE

NINE YEAR BAND RECORD OF THE CODLING MOTH

By J. W. RIGNEY AND A. B. FITE

LAS CRUCES CITIZEN
1918

NEW MEXICO AGRICULTURAL EXPERIMENT STATION

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ITRODUCTION

BY FABIAN GARCIA

The codling moth continues to be one of the worst pests that the apple grower has to contend with. This is particularly true in the lower and warmer irrigated valleys, where the larger apple orchards are growing. Because of the favorable climatic conditions and longer seasons in these localities there seems to be a larger number of generations than in the northern and higher sections of the State or in the East. There was little or no information available on the life history of this pest under these warm and favorable conditions. In order for the orchardists to combat this pest successfully in New Mexico, it is necessary to have further and more definite information on the life habits of this insect under these conditions. With this object in view, for a number of years the Experiment Station has been carrying on investigations, in order to obtain reliable information on this subject for the farmer.

Comprehensive life history investigations are being conducted. The compilation of these data will be published in bulletin form in the near future. Aside from these life history investigations there has been considerable information obtained on the movement of the larvae, by banding trees. The data secured in this way in the last nine years will be found in this bulletin.

This work was started in 1907, though there were no larvae recorded that year, on account of an unusually severe and late frost occurring on the 22d of April, which destroyed practically all of the fruit in the Valley. There were just a few apples left on a few of the trees in some of the orchards. After this freeze had occurred the Experiment Station, in co-operation with the Doña Ana County Horticultural Board, made an effort to destroy all of the apples which remained on the trees. In order to do this the Valley was sectioned off into districts, and inspectors were commissioned to go over all of the orchards and destroy all apples that could be found on the trees. This was done during May and June. By the time the work was completed a few larvae were found in some of the apples, which were destroyed. The object of the work at this time was to destroy all of the apples that the frosts had left, in order to starve out the codling moth and ascertain, if possible, whether this would permanently eradicate the pest in the Valley. There were very few apples shipped into the Valley during 1907. Those that were brought in were inspected, and all the wormy ones were destroyed.

During 1907 and 1908 no worms were found under the bands worked. In 1909 there were no larvae found in the earlier part of the season; and it was not until July 22 that any larvae were observed. On September

2, 1909, all of the apples were picked from a Mammoth Black Twig tree, growing on the south side of the College road and west of the main ditch. Out of the 135 apples gathered, 116 were sound and 19 (or 13%) wormy.

The attempt to eradicate the codling moth permanently, by means of starvation, did not prove to be a success, although the heavy crop of 1908 and about 90% of that of 1909 was sound; yet the codling moth began to reinfest the orchards toward the last of the season of 1909. In 1910 the orchards, towards the last of the season, were about as badly infested as they had been before the severe freeze of 1907.

This gives some information as to the improbability of entirely eradicating the codling moth from any district when all of the fruit is killed by a freeze in the spring. But it does show this: that in localities where the fruit is occasionally entirely destroyed by a freeze, at least the two following years are likely to be free or almost free from the codling moth; and probably this is one of the reasons why the fruit growers in the colder and higher districts are less troubled by this pest.

The information given in this bulletin, by means of the tables and life curves, is a record of the observations made from the banded trees during the investigation.

NINE YEAR BAND RECORD OF THE CODLING MOTH

OBJECTS.

To secure data on some of the different phases of the life history of the codling moth, such as (1) the length of the different broods; (2) the daily movement of the larvae; (3) the time of occurrence of the maximums of the different broods; (4) whether the larvae go down the trunks of the trees to cocooning places, or whether they reach the ground and then go to the trunks of the trees; (5) to determine whether the larvae are predominantly nocturnal or diurnal in moving from the apple to cocooning places; (6) to secure data on the cost and effectiveness of banding trees as an orchard practice in combating the codling moth.

METHODS OF PROCEDURE.

Bands were placed around the trunks of trees in neighboring orchards. These bands were made by so folding strips of dark colored canton flannel about one foot wide and three feet long that they were from four to six inches wide and three feet long. They were folded once, thus making two thicknesses of cloth, and were long enough to reach around the tree and lap about three inches. A dark colored cloth was used, as it was found that the white was not as attractive to the larvae. This conclusion was arrived at after sewing the end of a dark band to that of a white band in such a manner that they could be placed about the tree as one band. The dark color reached half way around the tree and the light color the other half. Very few larvae were captured under the light colored half as compared to the number from the dark half.

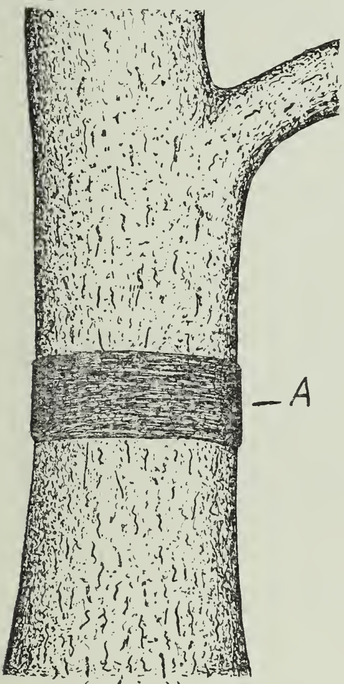

Fig. 1.
A—Cloth band around tree.

The bands were drawn tightly around the trees and the ends fastened together with small hooks so that they could be removed, unfolded and carefully examined. Not many larvae got into the folds of the bands, most of them getting between the bands and the trees.

Some of the bands were examined about eight o'clock of mornings and again about an hour before sundown.

Other bands were examined only once a week. Most of the trees had simply one cloth band around them. Some had a band of Tree Tanglefoot placed about them and a cloth band above it and one below. The band of Tree Tanglefoot was about four inches wide and was kept freshened, so that larvae could not cross it. (See page 30.) These are spoken of as "Double Bands."

The bands were taken from the trees and carefully searched for larvae, which were placed in bottles so they could be taken to the breeding cage for use. No living larvae were left in the orchard, once they were found. As soon as a band was examined the number of larvae found in and under it was recorded in a field note book under the number of the tree from which the band was taken. The band was then put back in place. The numbers found in the morning and those in the evening were totaled to get the figures for the "Daily Life Curves," and from other data were plotted the "Morning and Evening Life Curves," "Daily Double Band Records," and the "Weekly Life Curves."

DISCUSSION OF DAILY LIFE CURVES.

1907.

Although the apple crop was destroyed by frost in 1907, a band record was kept. This was to ascertain whether the codling moth could survive in the absence of fruit of any kind to feed upon.

Forty trees were banded; twenty of these were examined daily and twenty weekly for the entire season. No larvae were found.

1908.

There was a heavy crop of apples in 1908. Twenty trees were banded and were examined every day during the entire season, but not a larva was found. Many orchards of the Valley were examined continuously

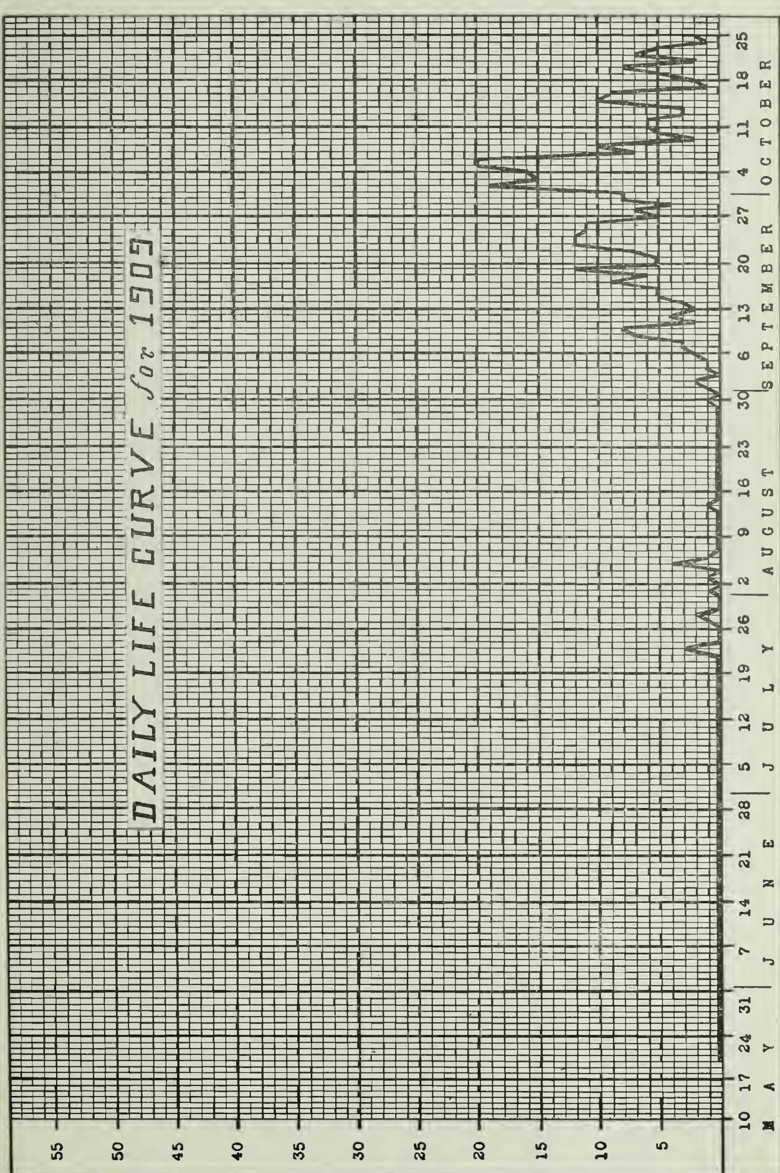
DAILY LIFE CURVE for 1909
55 50 45 40 35 30 25 20 15 10 5
10 17 24 31 7 14 21 28 5 12 19 26 2 9 16 23 30 6 13 20 27 4 11 18 25
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER

Fig. 2.

throughout the summer and fall, and toward the latter part of the season only a few wormy apples were found. This shows that the destruction of the fruit crop in 1907 almost exterminated the codling moth.

1909.

There were thirty-nine trees banded in an isolated orchard. It seems that no codling moths survived the season of 1907 in this orchard, for as stated above, no larvae were found in it in 1908. The twentieth annual report of this Station states that a good many larvae were found in some of the other orchards in the fall of 1908, and that in these the wormy apples were quite noticeable by the first of July, 1909.

No larvae were found under the bands in 1909 until July 23. This is out of the ordinary, for there are worms in the apples long before this in normal years. The only thing this can be attributed to is the failure of the entire fruit crop in 1907. From July 22 to August 7 seems to have been the first brood in this orchard for the season. This is very short and small. It covers sixteen days and there were thirty larvae.

The next brood began on August 29, or thirty-seven days after the first larvae were found, and continued until October 25. This would make fifty-seven days for this brood. However, there is a "low" on October 9, which might be the end of this brood and the beginning of another. Since this is rather large to have come from the previous one, some of these larvae may have been from moths from another orchard. This was the beginning of reinfestation.

1910.

Ten trees were banded. There are three rather distinct divisions of this curve. It reaches the zero line on July 3 and goes down to 17 on August 5. It goes lower

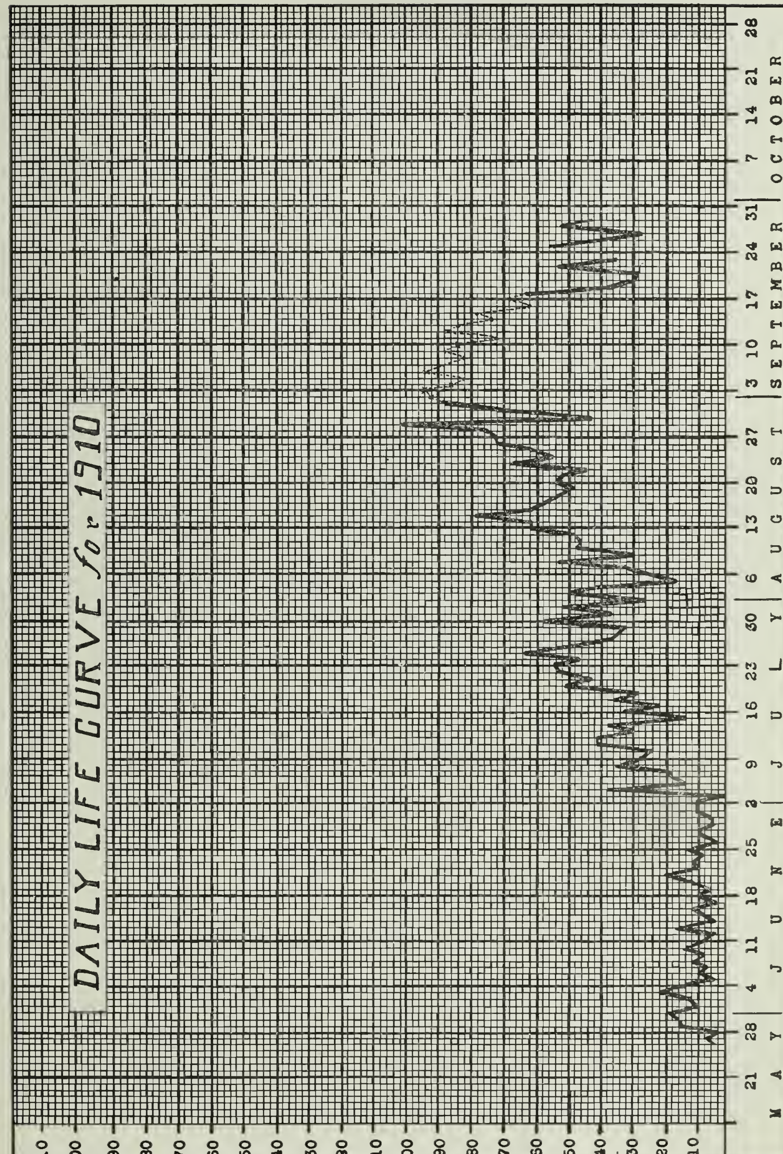
DAILY LIFE CURVE for 1910
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
M A Y
21 28
J U N E
4 11 18 25
J U L Y
2 9 16 23 30
A U G U S T
6 13 20 27
S E P T E M B E R
3 10 17 24 31
O C T O B E R
7 14 21 28

Fig. 3.

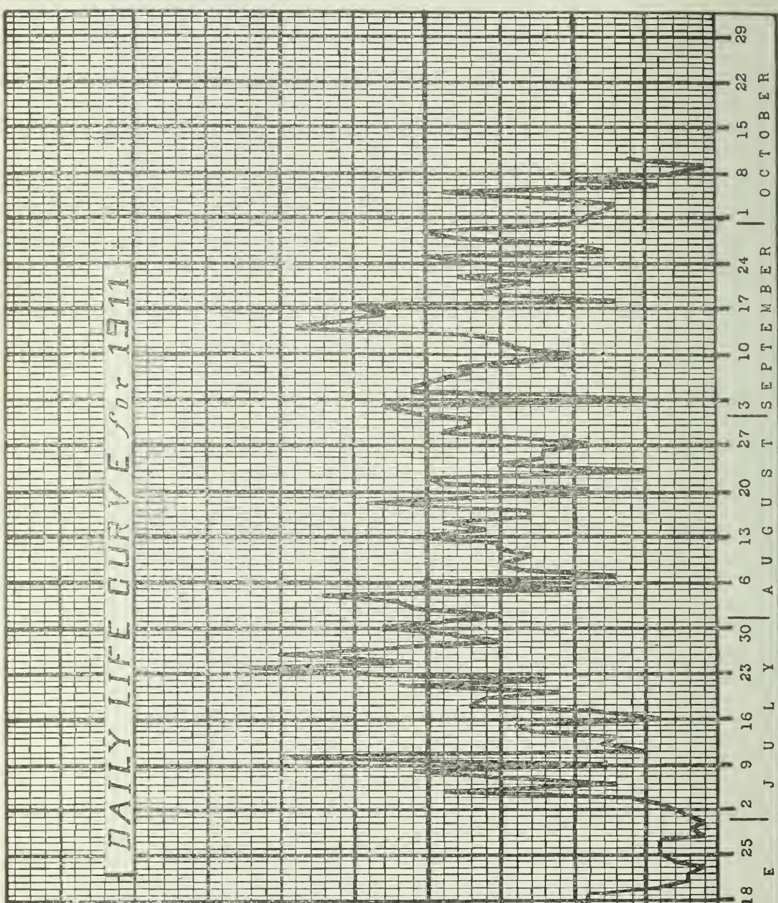
DAILY LIFE CURVE for 1911
45
40
35
30
25
20
15
10
5
M A Y
21 28
J U N E
4 11 18 25
J U L Y
2 9 16 23 30
A U G U S T
6 13 20 27
S E P T E M B E R
3 10 17 24
O C T O B E R
1 8 15 22 29

Fig. 4.

on July 15 than it does on August 5, but this is a more sudden drop, and the general direction of the curve is not so much downward. The curve discontinues on September 1 for sixteen days. This was caused by excessive irrigation given by the owner of the orchard. The bands were kept under water, so they could not be examined during this period.

There was no rain during the month of May and only .25 of an inch in June, which fell on the 25th. The curve goes up a little on this date. It rained on July 10, 14, 16 and 27. The amounts were .60, .08, .14, and .28 inch, respectively. The curve drops on the 10th and 27th and rises on the other dates.

It rained on August 4, 7, 10, 14, 19 and 29. The amounts were .61, .03, .01, .05 and .31 inch, respectively. The curve drops on the 4th and 19th and rises on the other dates.

It rained .23 inch on September 16, but there is a break in the curve at this time.

1911.

Fourteen trees were banded. There were fewer larvae per day, on the average, in 1911 than in 1910. On account of this the daily variations in the curve seem greater than they really are, as the space representing a day is larger than in the other curves.

There is one very distinct division in the curve ending about June 25, and, taking the curve as a whole, three other less distinct divisions ending about August 7, September 10 and October 10, respectively. The fluctuations in this curve are so frequent and of so short duration that it is almost impossible to interpret it.

It rained on May 9 and 31. The amounts are .09 and .03 inch, respectively. There was a rise in the curve on the 31st.

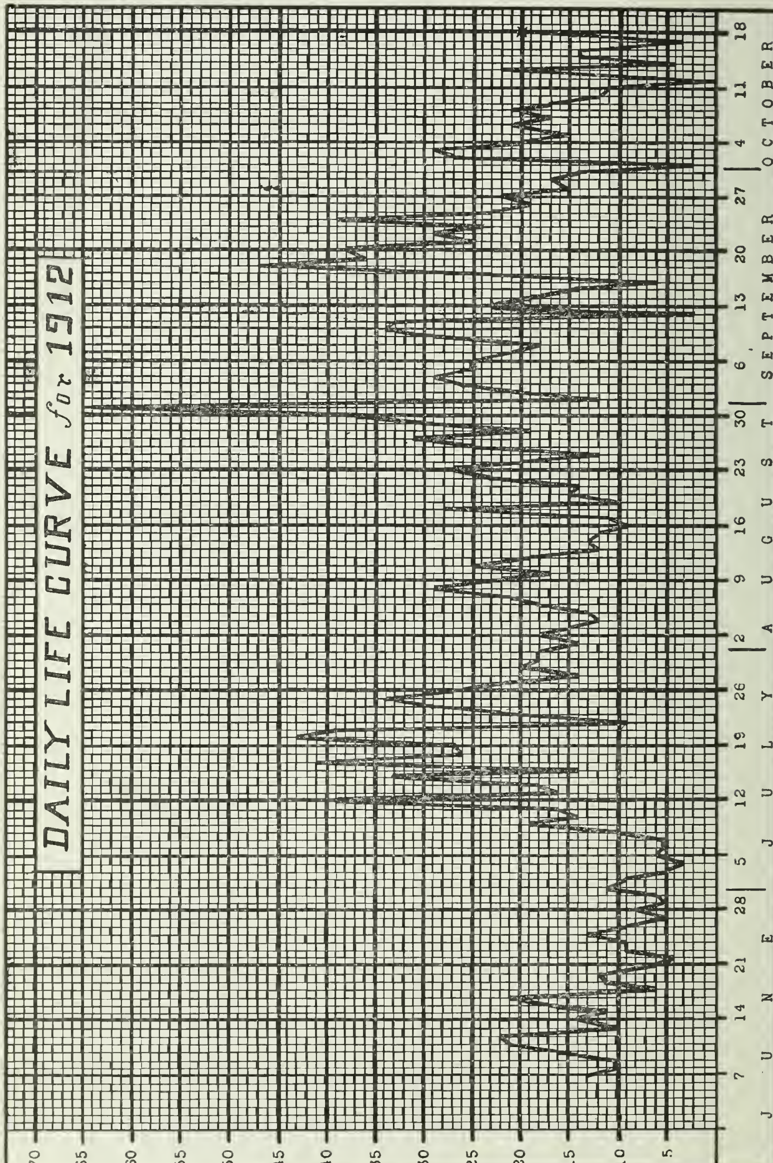
DAILY LIFE CURVE for 1912
70
65
60
55
50
45
40
35
30
25
20
15
10
5
JUNE
7
14
21
28
JULY
5
12
19
26
AUGUST
2
9
16
23
30
SEPTEMBER
6
13
20
27
OCTOBER
4
11
18

Fig. 5.

It rained June 11, 13, 20, and 22. The amounts were .04, .23, .03 and .03 inch, respectively. The curve drops on the 20th and 22nd and rises on the other dates.

It rained on July 1, 2, 6, 9, 10, 13, 14, 15, and 27. The amounts were .25, .02, .11, .27, .30, .06, .10, .10 and .15 inch, respectively. The curve drops on July 6, 9, 13 and 27 and rises on the other dates.

It rained August 19 and 25. The amounts were .09 and .05 inch, respectively. The curve drops on both of these dates.

It rained on September 9, 17, 18, 29 and 30. The amounts were .88, .03, .17, .06 and .04 inch, respectively. The curve drops on September 9, 18, and 30 and rises on the other dates.

It rained on October 4 and 5. The amounts were .12 and .08 inch. The curve rises on both these dates.

1912.

Seven trees were banded. This curve has four quite distinct divisions. The first ends about July 5, the second about August 9, the third about September 13 and the fourth about October 18.

It rained on June 8, 22, and 23. The amounts were .01, .10, .01 inch, respectively. The curve drops on the 8th and 22nd and rises on the 23rd.

It rained on July 2, 10, 15, 21, 23, 24, 25, 28 and 29. The amounts were .05, .01, .01, .01, .16, .11, .05, .07, and .01 inch, respectively. The curve drops on July 2, 10, 21 and 28 and rises on the other dates.

It rained on August 2, 4, 12, 13, 15, 16, 18, 19, 20, 23, 25, 27, 29 and 31. The amounts were .13, .20, .35, .01, .69, .03, .73, .06, .15, .13, 1.14, .98, .01 and .43 inch, respectively. The curve drops on August 4, 12, 13, 15, 16, 19, 25, and rises on the other dates; but there is considerable drop on the 28th, just after the .98 inch of rain. This rain fell during the evening of the 27th.

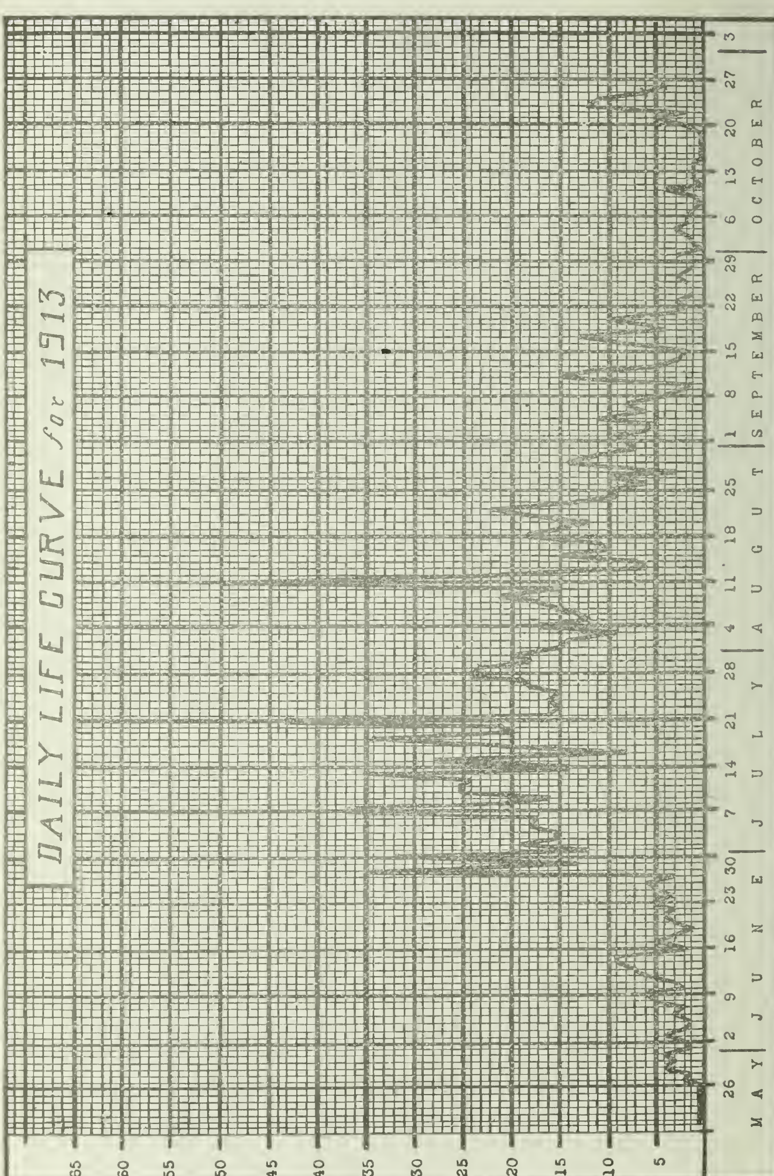
DAILY LIFE CURVE for 1913
MAY JUNE JULY AUGUST SEPTEMBER OCTOBER
26 2 9 16 23 30 7 14 21 28 4 11 18 25 1 8 15 22 29 6 13 20 27 3
65 60 55 50 45 40 35 30 25 20 15 10 5

Fig. 6.

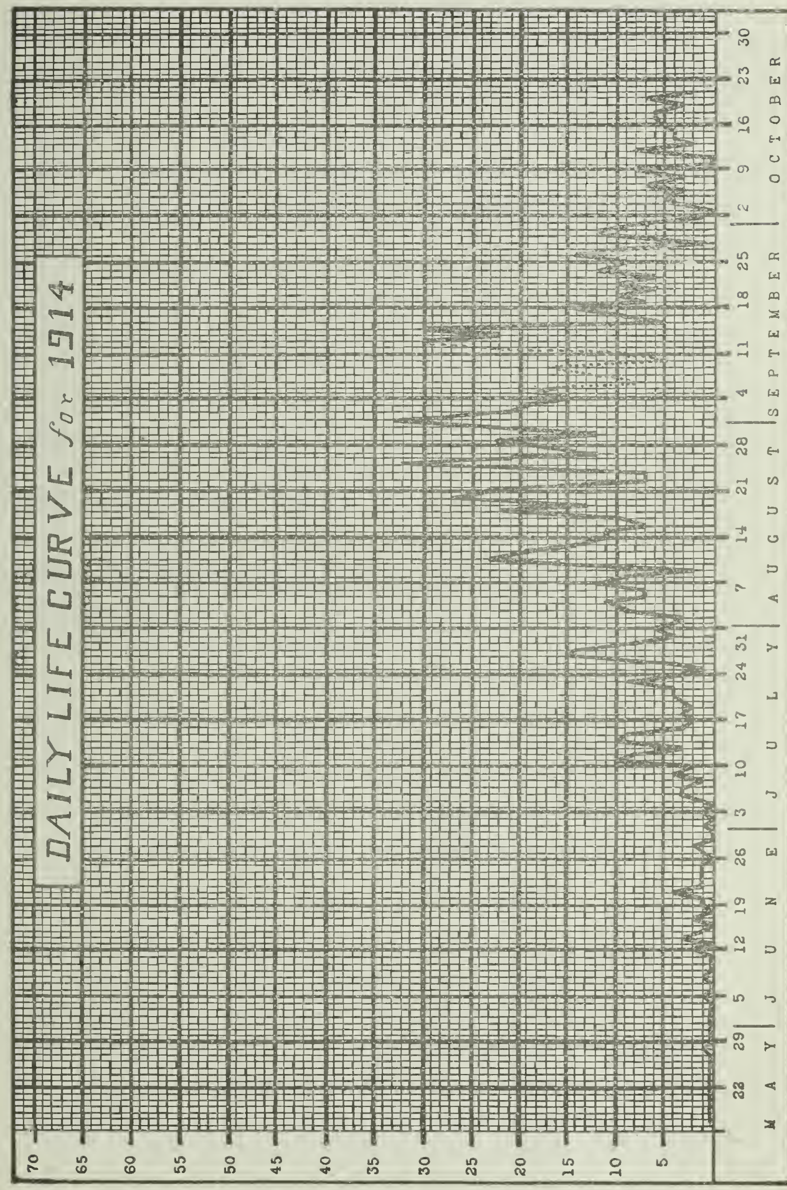
DAILY LIFE CURVE for 1914
70 65 60 55 50 45 40 35 30 25 20 15 10 5
22 29 5 12 19 26 3 10 17 24 31 7 14 21 28 4 11 18 25 2 9 16 23 30
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER

Fig. 7.

It rained on September 1, 2, 11, 12, and 30. The amounts were .17, .04, .01, .40, and .08. The curve drops on September 1, 11, 12 and 30.

It rained on October 1, 7, 8, 12, and 14. The amounts were .35, .18, .14, .16 and .14 inch, respectively. The curve drops on October 1, 7, 12 and 14, and rises on the other date.

1913.

Ten trees were banded. The divisions on this curve are not so distinct as they are on the other curves. The field notes state that the crop was ruined by the San Jose scale, and most of the apples fell early. Therefore this would not be considered a normal curve.

It rained on May 27, .01 of an inch, and there was a rise on this date.

It rained on June 2, 7, 8, 9, 15, 18, 19, 21, 23. The amounts were .01, .77, .01, .36, .55, .15, .06, .18 and .54 inch, respectively. The curve drops on June 2, 7, 15, 18 and 19 and rises on the other dates.

It rained July 13, 16, 21, and 30. The amounts were .50, .02, .62, and .13 inch, respectively. The curve drops on the 16th and 30th and rises on the other dates; but there were drops on both the 14th and 22nd and it may be that the rains came during the evening of the 13th and 21st.

It rained on August 1, 4, 5, 10, 11, 18, 19, 22, 25, 28 and 31. The amounts were .27, .02, .08, .01, .57, .07, .01, .03, .14, .03, and .10 inch, respectively. The curve drops on 1, 4, 5, 10, 18, 19, 22, and 31 and rises on the other dates.

It rained on September 2, 3, 4, 5, 10, 22, 24, 25, and 26. The amounts were .13, .12, .07, .13, .34, .12, .02, .34 and .43 inch, respectively. The curve drops on September 3, 4, 10, 22, 24, 25 and 26 and rises on the other dates.

There was no rain during the month of October.

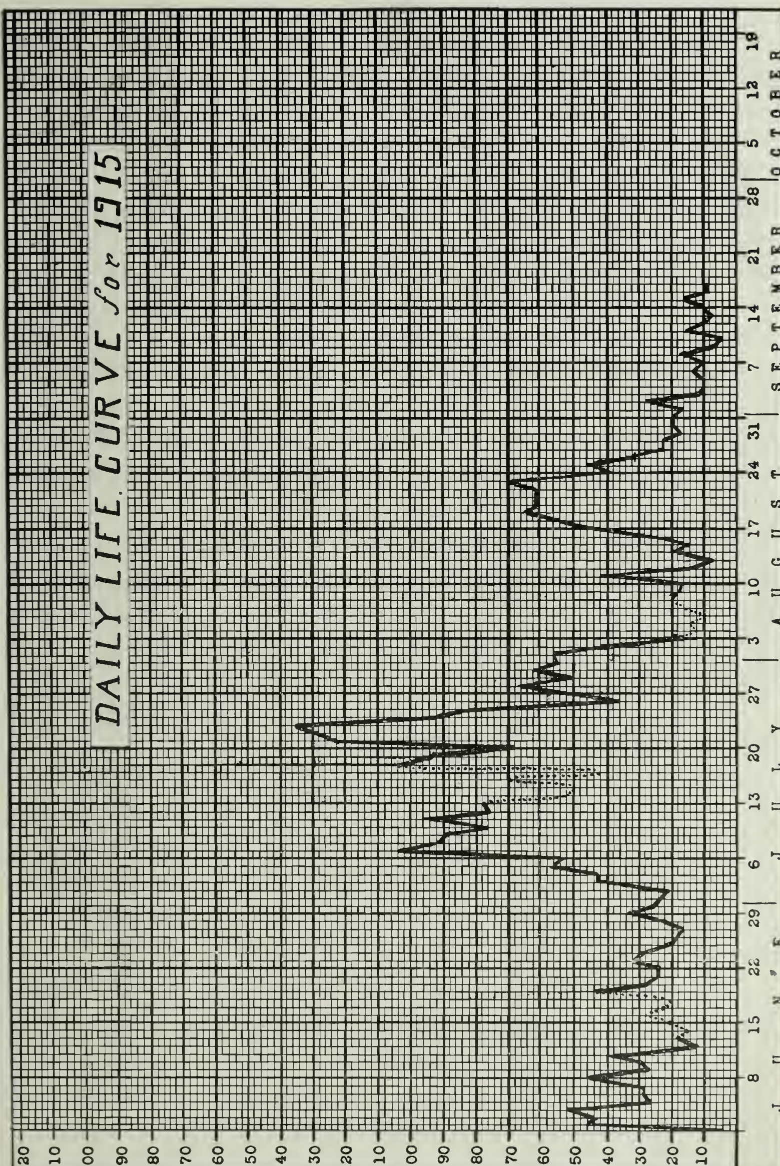
DAILY LIFE CURVE for 1915
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
8
15
22
29
6
13
20
27
3
10
17
24
31
7
14
21
28
5
13
19
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220

Fig. 8.

1914.

Ten trees were banded. The 1914 Daily Curve is not considered normal, since the data for it were secured in the same orchard as those for 1913. Since the later broods in 1913 were reduced, making fewer wintering-over larvae, the first and second broods in 1914 were smaller than they would have been otherwise. The orchard was sprayed in the early spring of 1914 with a scalicide and the trees cleaned up in good condition, so the last of the season should be about what would be expected under normal conditions. The curve shows a comparatively large number of larvae towards the last of the season.

It rained on June 1, 10, 14, 17 and 26. The amounts were .58, .37, .15, .66 and .09 inch, respectively. This is very low for the month of June; therefore the effects of the weather are not pronounced.

It rained on July 1, 6, 7, 16, 17, 18, 19, 22, 23, 27 and 28. The amounts were .27, .32, .40, .19, .05, .06, .56, .05, .09, .04 and .05 inch, respectively. The curve drops on July 16, 17, 18 and 19 and rises on the other dates. The curve is still low, however.

The curve is up to about normal, as compared to previous years, during August. It rained on August 9, 10, 20, 21, 23, 24 and 29. The amounts were .04, .04, .39, .07, .05, .35, and .54 inch, respectively. The curve drops on August 9, 21, 23 and 24, and rises on the other dates.

It rained on September 3, 6, 10, 15, 17 and 19. The amounts were .05, .06, .51, .03 and .22 inch, respectively. The curve drops on September 3, 6 and 19.

It rained on October 20 and 21; but this is just at the end of the curve and is not considered.

1915.

Ten trees were banded. The data for this curve were secured from an unsprayed orchard. This was the only unsprayed orchard used for the daily band records.

There are three distinct divisions of the curve. The first ends about July 2, the second about August 6, and the third on September 17. However, the bands were not examined after this date and it might be that larvae came out later. The curve starts a little late. The divisions are very distinct and must represent broods. The second is much the largest, but the field notes state that the apples were about all off the trees five or six weeks before the regular time for harvesting. This may have caused the last brood to be much smaller, relatively, than it would have been otherwise. This curve is not so erratic as the other daily curves.

There was no rain during the month of June. It rained July 11, 15, 19, 24 and 25. The amounts were .25, .06, .38, 1.06 and .49 inch, respectively. The curve drops on July 15, 19, 24 and 25.

It rained on August 5, 6, 25, 27 and 28. The amounts were .13, 1.03, .01, .04, and .11 inch, respectively. The curve drops on the 27th and 28th.

It rained on September 4, 14, and 17. The amounts were .31, .02, and .82 inch, respectively. The curve drops on the 4th and 17th.

AVERAGE OF DAILY LIFE CURVES FOR 6 YEARS.

Before entering into a general discussion of this curve, attention should be called to a few details. The data were secured by combining six of the curves, covering six years of investigation, and using their average to plot this curve.

Because of the rapid fluctuations in the daily curves for each year,—which may have been caused by a number of things, such as temperature, rain, irrigation, application of sprays, etc., also the marked variation in the curves for different years due to the dissimilarity of seasons and to orchard conditions, such as San Jose scale infestations and the falling off of practically all apples before the season was over, in unsprayed orchards,—

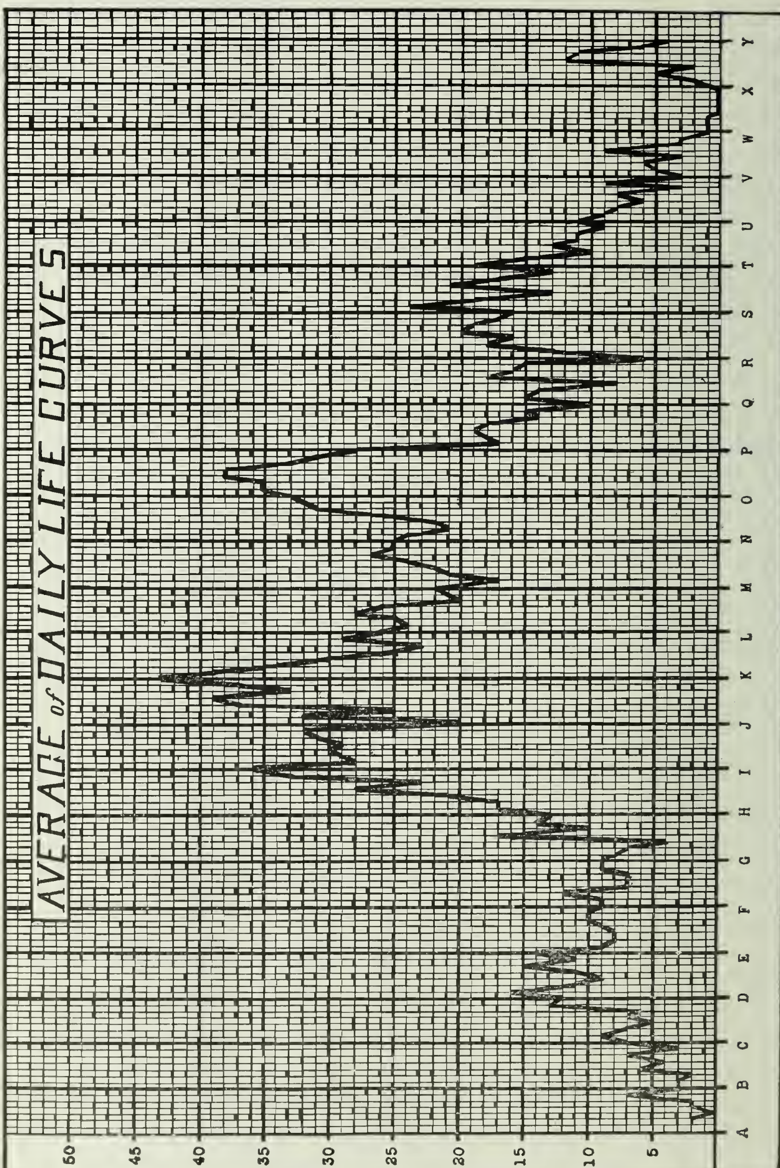
AVERAGE of DAILY LIFE CURVES
50
45
40
35
30
25
20
15
10
5
A B C D E F G H I J K L M N O P Q R S T U V W X Y

Fig. 9.

it was found to be almost impossible to interpret the curves for the different years or to draw any definite conclusions from the series of curves, as regards the number of broods of codling moth (if there are distinct broods), the length of the life cycle of the different broods, and where each brood begins and ends. As a result of these difficulties it was decided that a curve combining all the others in such a way as to bring the corresponding broods for the different years together would tend to minimize all abnormal fluctuations and show up the different broods more clearly.

It will be noticed that all the daily curves, except that of 1909, which was not used in making this curve, have a *distinct drop between the first and second broods.* This being a point in common, the dates of this drop for the different years were brought together to make corresponding broods coincide. For example, in most cases the second brood begins about July 1, but some years about June 27; hence July 1 of one year and June 27 of another were placed together; and so on. For this reason it was found necessary to use letters at the bottom of the figure instead of dates, but the drop three days after G came about July 1 for any of the six years. In like manner approximate dates may be given to all the letters as follows:—

A, May 17; B, May 24; C, May 31; D, June 7; E, June 14; F, June 21; G, June 28; H, July 5; I, July 12; J, July 19; K, July 26; L, August 2; M, August 9; N, August 16; O, August 23; P, August 30; Q, September 6; R, September 13; S, September 20; T, September 27; U, October 4; V, October 11; W, October 18; X, October 25; Y, November 1.

The horizontal lines represent one larva each and the vertical lines one day each, as in most of the daily life curves.

There are four divisions of this curve which are so distinct that they undoubtedly represent broods of the different generations. For this reason the term brood will be used in the remainder of this discussion. The term brood is generally used in speaking of any stage of a generation. For example, a brood of eggs, larvae, pupae, or moths. A life cycle consists of the egg, larval, pupal and moth stages.

The first division begins one day after A and ends three days after G and is about 44 days in length. The second begins three days after G and ends one day after M and is about 39 in length. The third begins one day after M and ends on R, making it about 34 days in length. The fourth begins on R and ends three days after W, which makes it about 38 days in length.

The observations were made later in 1913 than in any other year, and also had the low between the first and second broods later than any of the others, consequently it is the only one which runs past W. Since this is true, and it was abnormal, the curve past this point is not regarded as important.

Since these investigations deal with the larval stage only, the length of the life cycle of the different generations will have to be determined from the data that are to be published in a life history bulletin, because from the band record data there is no way of determining the length of the different stages.

As there are four divisions of the curve it would be well to compare them. There is a less distinct peak in the first than in the second, third, or fourth; which suggests that the spring moths emerged and deposited eggs at a somewhat uniform rate for several weeks. The second division represents a much greater number of larvae, although it is shorter than the first. Excessive irrigation on July 22, 1912, and heavy rains from July 16 to 19, 1914, came together on J and caused the decided drop in

the curve. The third brood does not represent as many larvae as the second and seems to be shorter. The second and third broods overlap more than either the first and second or the third and fourth, as shown by the lows between them. The fourth division is about as long as the first and not much larger, but by comparing it with 1910, 1911 and 1912 curves, it will be seen that it would have been much larger had 1913 and 1915 been normal years.

Since there is a greater overlapping of broods toward the middle of the season, the life cycle seems to have varied and gotten shorter during this period of warmer weather.

Probably the most important feature brought out by this curve is that the life cycle of the codling moth is not so long here as in many other places, since there were four distinct broods between May 18 and October 27—162 days—or an average of about 40 days per brood. Since this is true, it will be necessary to use a schedule to meet these conditions.

DISCUSSION OF MORNING AND EVENING LIFE CURVES.

1911.

Six bands were observed in the morning and evening, to determine whether most of the larvae travel in the day time or at night.

The number of larvae represented by the "Evening Curve" is relatively small. The curve goes above five in but five or six places. It averages 1.5 larva per day for the season.

The "Morning" curve is above five most of the time, above ten a great deal of the time, and goes as high as 32, on July 24. It would average about 10 larvae per day for the season. There were 1,405 larvae represented in the morning curve and only 237 in the evening; the

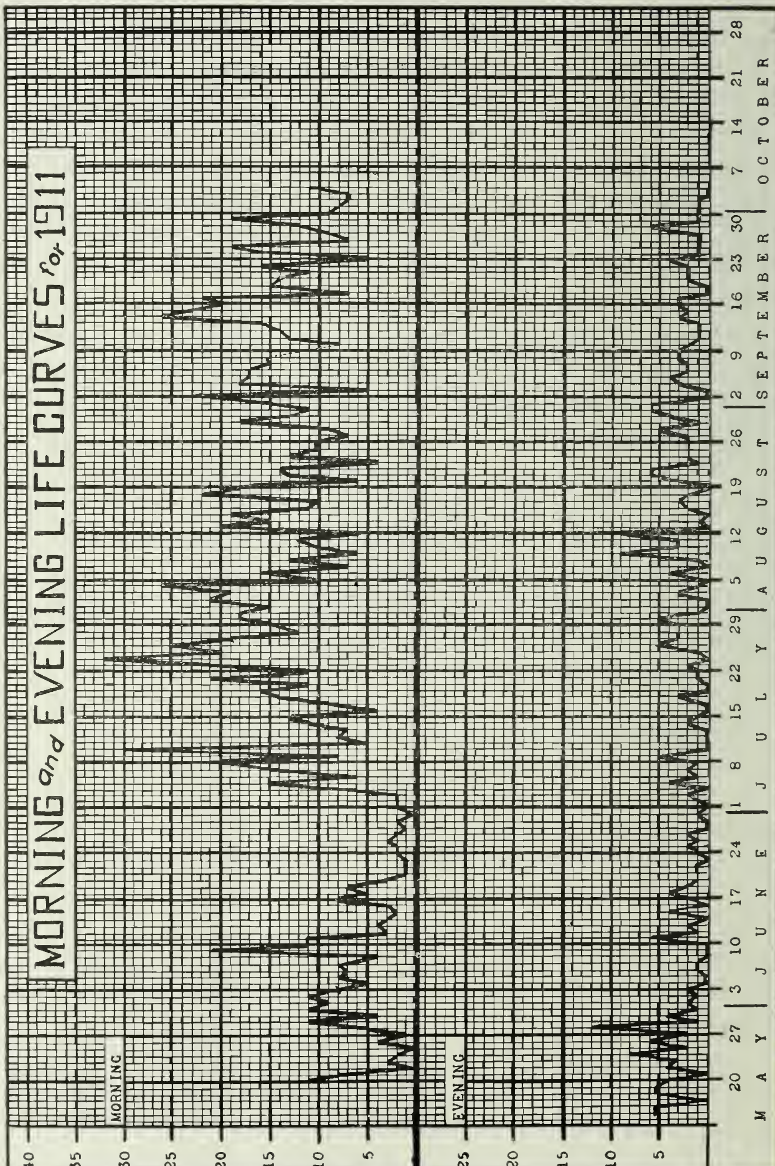
MORNING and EVENING LIFE CURVES for 1911
MORNING
EVENING
40 35 30 25 20 15 10 5
25 20 15 10 5
MAY 20 27
JUNE 3 10 17 24
JULY 1 8 15 22 29
AUGUST 5 12 19 26
SEPTEMBER 2 9 16 23 30
OCTOBER 7 14 21 28

Fig. 10.

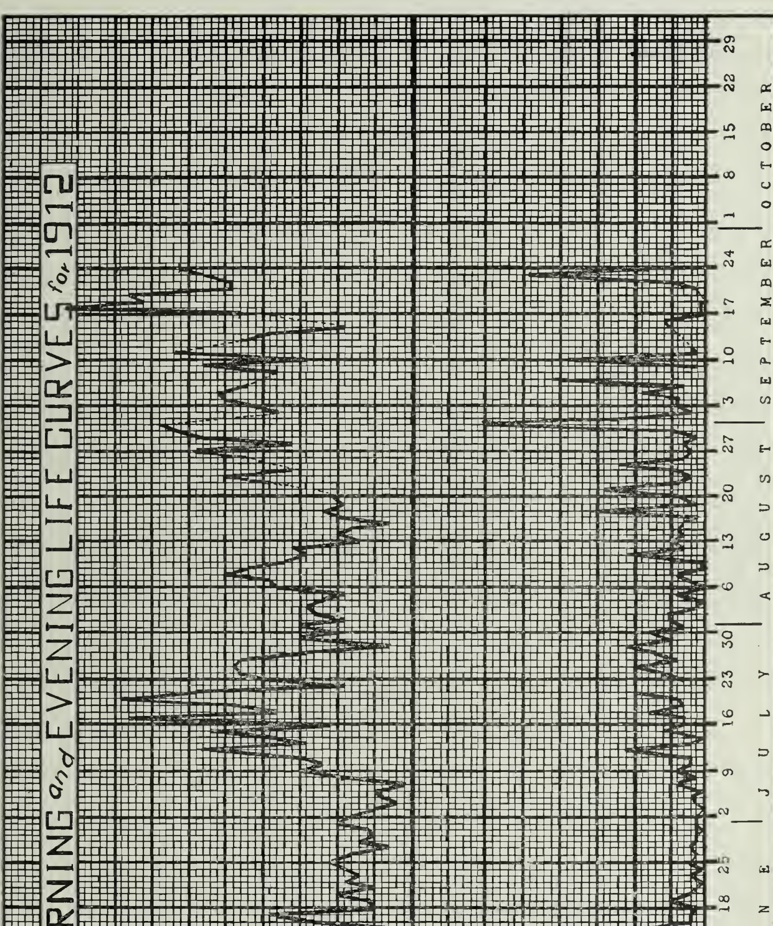
MORNING and EVENING LIFE CURVES for 1912
MORNING
EVENING
50 45 40 35 30 25 20 15 10 5
35 30 25 20 15 10 5
MAY 21 28
JUNE 4 11 18 25
JULY 2 9 16 23 30
AUGUST 6 13 20 27
SEPTEMBER 3 10 17 24
OCTOBER 1 8 15 22 29

Fig. 11.

morning lacking but 13 of having six times as many larvae as the evening curve.

1912.

Six trees were banded. The number of larvae represented by the evening curve is much smaller than for the morning curve. The evening curve runs along near the five line a great deal of the time, but goes up to thirty on August 31. This was right up and down, however, and does not represent many larvae. On the whole, this curve averages 7.7 larvae per day. The morning curve runs near the ten line until July 9, then about the twenty line until July 26, then about the fifteen line until August 20. For the remainder of the season it averaged above the twenty line. It averaged over sixteen larvae per day for the season. There are several breaks in the morning curve, yet there were 1719 larve and only 809 in the evening curve. There were a little over twice as many larvae in the morning as in the evening for this year.

1913.

Ten trees were used. The "Evening" curve runs below the five line to July 7, then about the 7 line to July 23, then, with the exception of August 1, 11 and 16, September 11 and 20 and October 23, below the five line, but reaches as many as sixteen larvae per day on two days. Taking it as a whole it averages a little over 2 larvae per day for the season.

The "Morning" curve goes below the five line in just a few more places than the evening curve goes above this line. It is above the ten line for about eight weeks, and above the fifteen line for about three weeks. It averages a little over 6 larvae per day for the season. It reaches 39 on July 21 and 38 on August 11.

There were 1083 larvae represented in the morning curve and 365 in the evening curve. Had there been 12

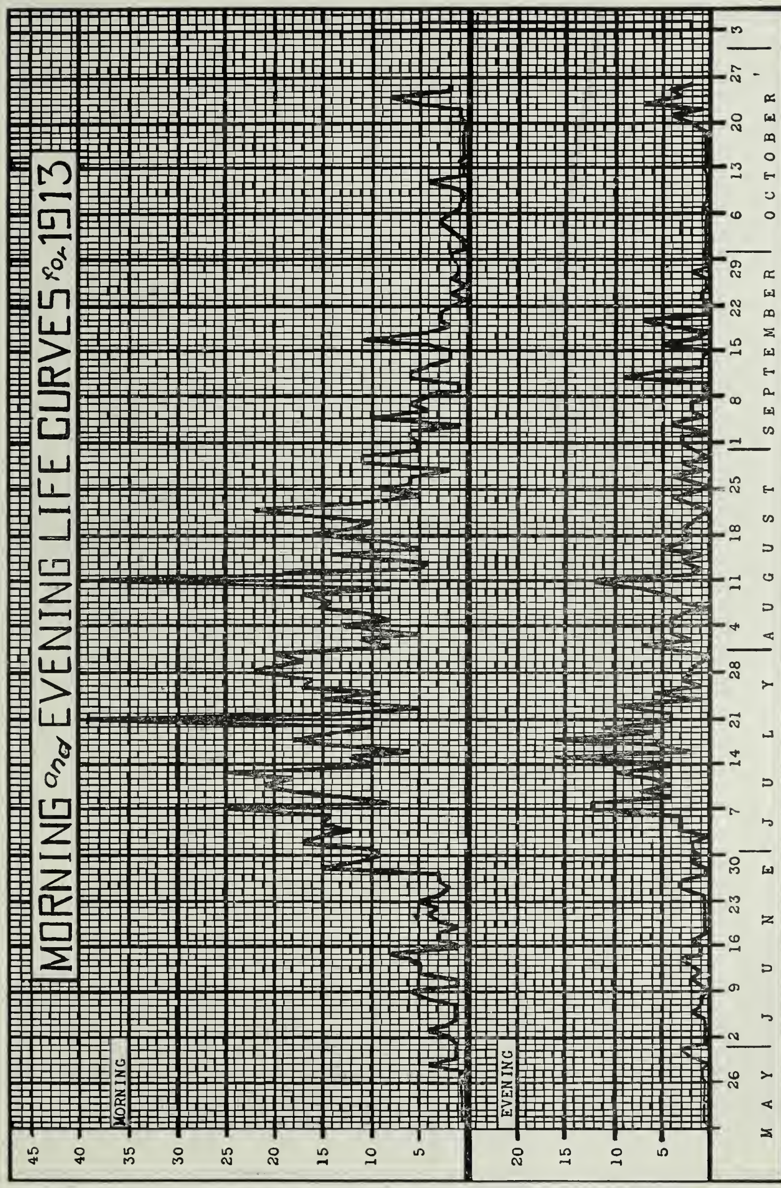
MORNING and EVENING LIFE CURVES for 1913
MORNING
EVENING
45 40 35 30 25 20 15 10 5
20 15 10 5
26 2 9 16 23 30 7 14 21 28 4 11 18 25 1 8 15 22 29 6 13 20 27 3
MAY JUNE JULY AUGUST SEPTEMBER OCTOBER

Fig. 12.

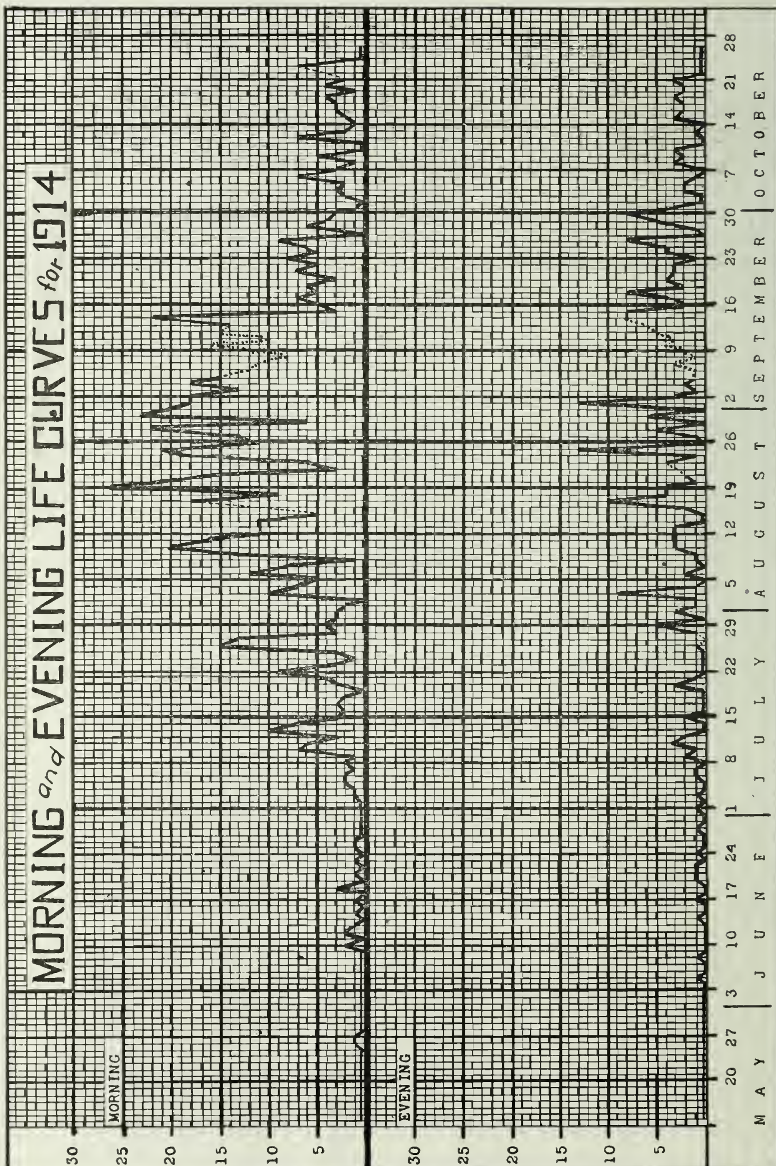
MORNING and EVENING LIFE CURVES for 1914
MORNING
EVENING
30
25
20
15
10
5
30
25
20
15
10
5
M A Y 20 27
J U N E 3 10 17 24
J U L Y 1 8 15 22 29
A U G U S T 5 12 19 26
S E P T E M B E R 2 9 16 23 30
O C T O B E R 7 14 21 28

Fig. 13.

more larvae in the morning, this curve would have totaled three times as many larvae as the evening.

1914.

Ten bands were worked. The "Evening" curve is quite low for several weeks at the beginning of the season, not averaging one larva per day until August 24. Most of the time it runs below the five line and averages about 1.5 larva per day. The "Morning" curve is also quite low for the first few weeks of the season (until July 9), after which it runs about the five line for five weeks and then about the ten line for almost six weeks; when it drops back to about the five line. It goes to twenty-six larvae per day on August 19, and averages about 5.1 larvae per day.

There were 845 larvae represented in the morning curve and 261 in the evening, or about a third as many in the evening as in the morning.

These curves show clearly that there are many more larvae leaving the apples and going to a pupating place at night than during the day; there being 5052 total for four years for morning, and 1672 total for four years for evening, or three to one. This, of course, aids in avoiding their natural enemies and adds to the difficulty of combating them.

DISCUSSION OF THE DAILY DOUBLE BAND RECORD CURVES.

1911.

Fig. 14 shows the manner in which the trees were banded. A and C are the cloth bands and B is a band of tree tanglefoot. A is the upper band and C is the lower. The trees were banded in this way to determine whether the larvae crawl down the trees or reach the ground in some manner and then go to the trees.

The curve for the upper band runs, on the average, slightly above the five line until July 19, then above the

ten line until August 15 and back to the five line the remainder of the season. It averaged a little over 6 per day. There were 863 larvae.

The curve for the lower band runs below the five line most of the time until the twentieth of August, then on an average it is about the six line for the remainder of the season. The lower curve is much larger in proportion to the size of the upper towards the last of the season than it is the first. This is probably caused by a greater per cent of larvae falling with the apples as the season advances. The lower curve averaged three larvae per day. There were 487 larvae. Four trees were banded.

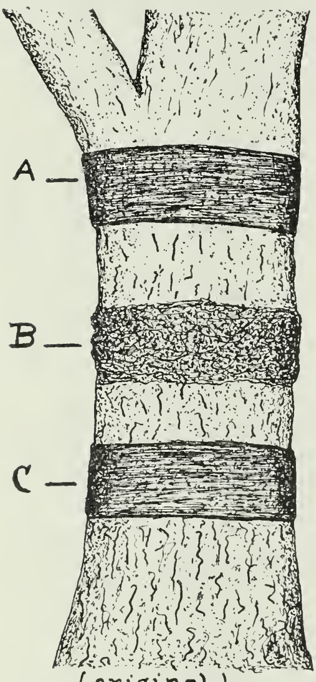

Fig. 14.
A—Upper band.
B—Band of tree tanglefoot.
C—Lower band.

1912.

Three trees were banded. The curve for the upper band runs, on the average, about the five line for the first four weeks, then about the fourteen line for the next three weeks and for the remainder of the season it is not far from the five line. It averages more larvae per day during the first part of the season than the last. The average for the season was about seven larvae per day. There were 932 larvae.

The curve for the lower band runs below the five line for the first ten weeks, except July 20 and 22, then averages about nine per day for the remainder of the season.

The last nine weeks of the curve represent many more larvae than the first ten weeks. As mentioned in regard to the lower curve for 1911, this is no doubt caused by the apples carrying a greater per cent of the larvae to the ground toward the end of the season. The number of larvae for the lower curve is 802, or an average of about six larvae per day.

1913.

Three trees were banded. Each of the curves for 1913 represents but a few larvae and they are quite similar in outline and in the number of larvae. There is not the large number toward the last of the season on the lower curve as was the case with 1911 and 1912. It should be remembered that this orchard was badly infested with the San Jose scale and that the apples fell badly during the early part of the season. However, the lower curve is a little larger in proportion from the last of August to the end of the season. The total number of larvae for the upper curve is 305 and for the lower 250. The upper averaged about 2 larvae per day and the lower about 1.6.

1914.

Three trees were banded. The first part of the upper curve is exceptionally low. This is doubtless due to the later broods for the previous year being greatly reduced. With the exception of July 28 it runs below the five line until August 4, and runs a little above it for 6 weeks, then runs much below it for about five weeks. The greatest number per day was 12, on the first of September. The total number of larvae was 296, or an average of 1.93 larva per day.

The lower curve runs below the five line until August 24, except on August 12 and 19, and averages about 5.5, fluctuating considerably, for about five weeks. Then it averages much below this line for the remainder of the season. The greatest number was 13, on September 13

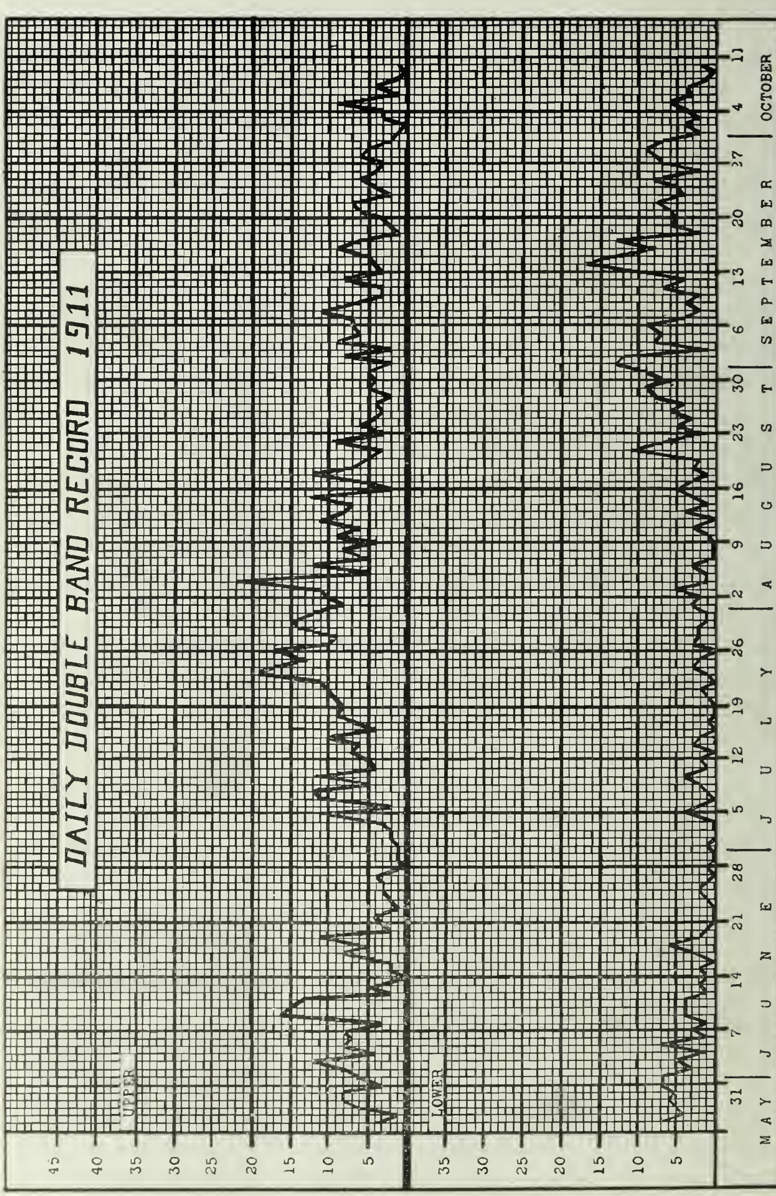
DAILY DOUBLE BAND RECORD 1911
UPPER
LOWER
45 40 35 30 25 20 15 10 5
35 30 25 20 15 10 5
31 7 14 21 28 5 12 19 26 2 9 16 23 30 6 13 20 27 4 11
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER

Fig. 15.

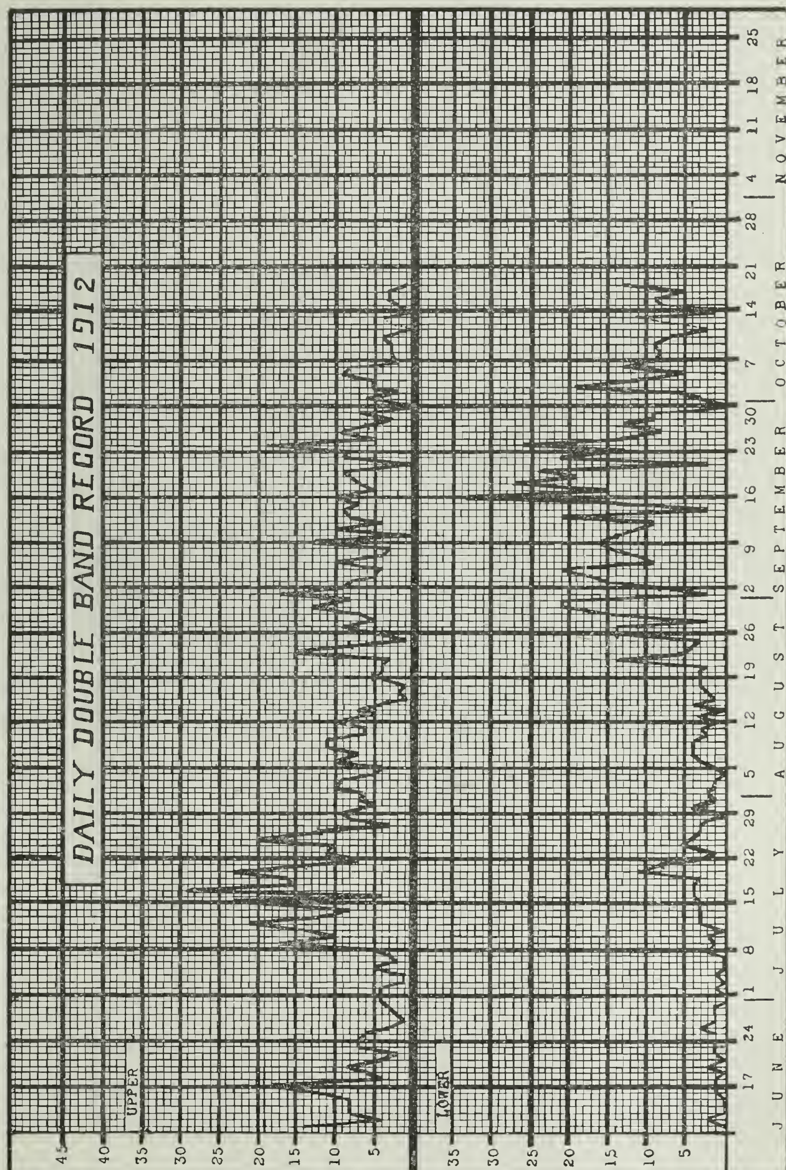
DAILY DOUBLE BAND RECORD 1912
UPPER
LOWER
45 40 35 30 25 20 15 10 5
35 30 25 20 15 10 5
JUNE 17 24
JULY 1 8 15 22 29
AUGUST 5 12 19 26
SEPTEMBER 2 9 16 23 30
OCTOBER 7 14 21 28
NOVEMBER 4 11 18 25

Fig. 16.

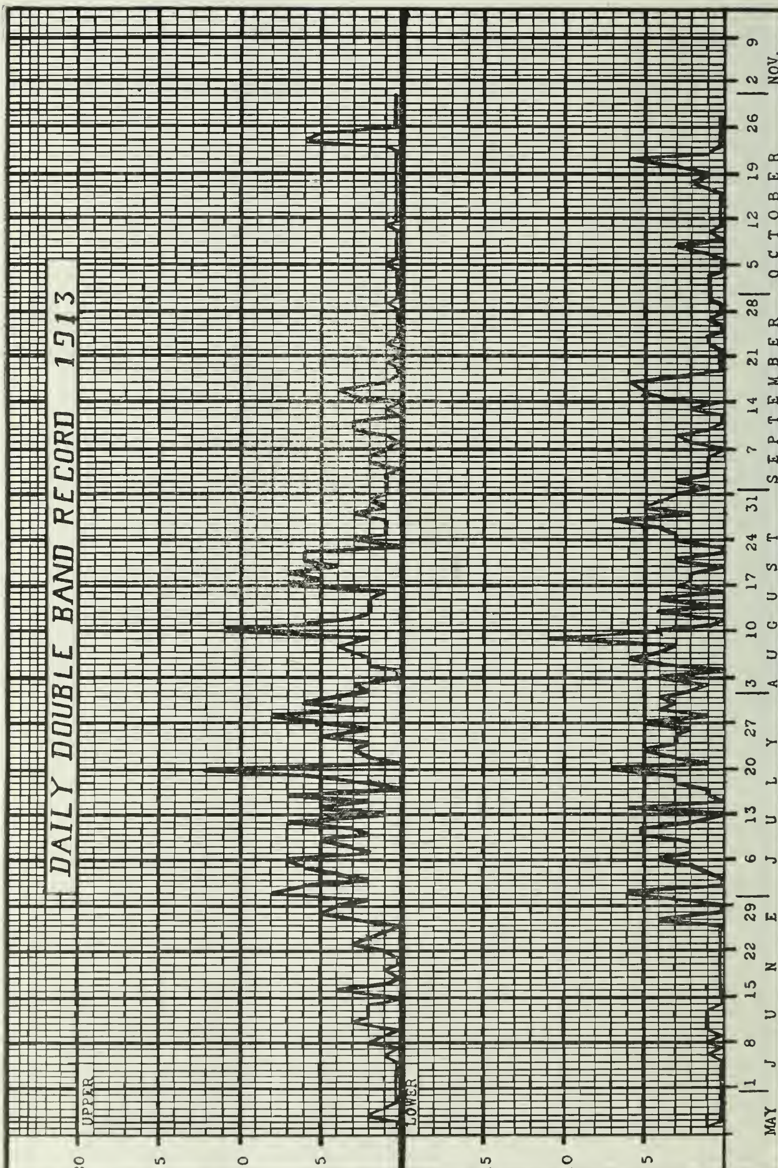
DAILY DOUBLE BAND RECORD 1913
UPPER
LOWER
20
15
10
5
15
10
5
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOV.
1 8 15 22 29 6 13 20 27 3 10 17 24 31 7 14 21 28 5 12 19 26 2 9

Fig. 17.

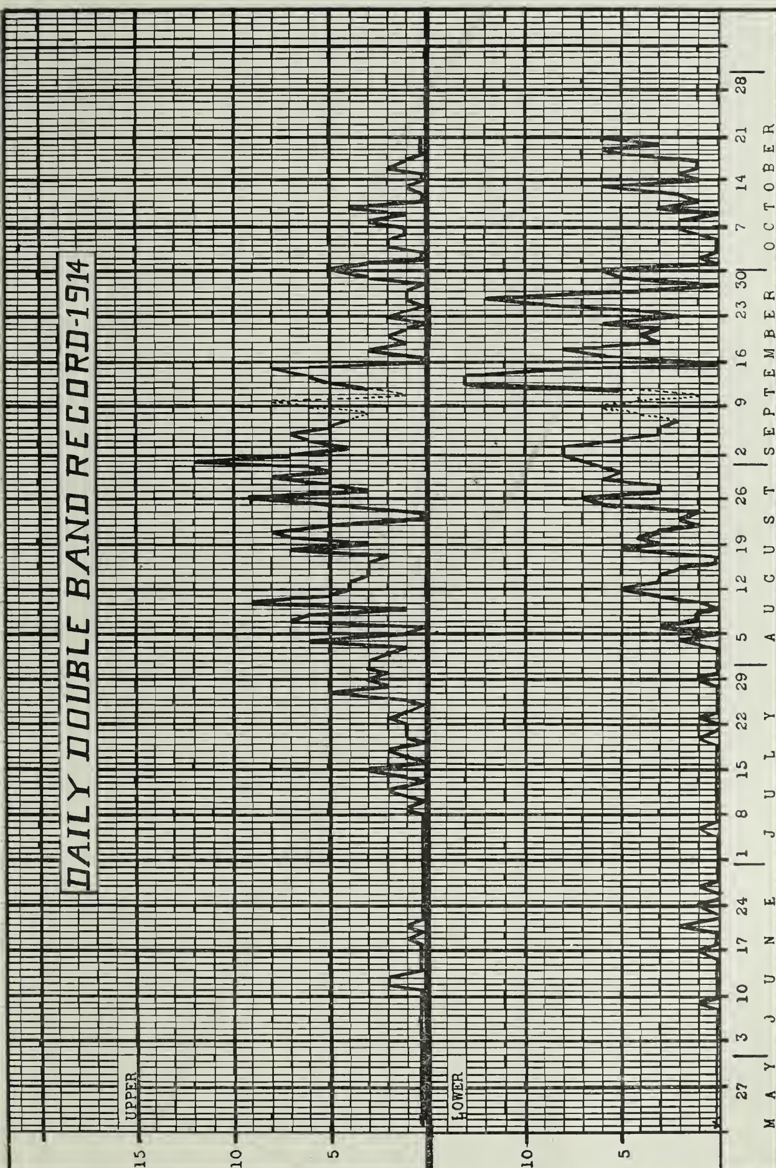
DAILY DOUBLE BAND RECORD-1914
UPPER
LOWER
15
10
5
10
5
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
27
3
10
17
24
1
8
15
22
29
5
12
19
26
2
9
16
23
30
7
14
21
28

Fig. 18.

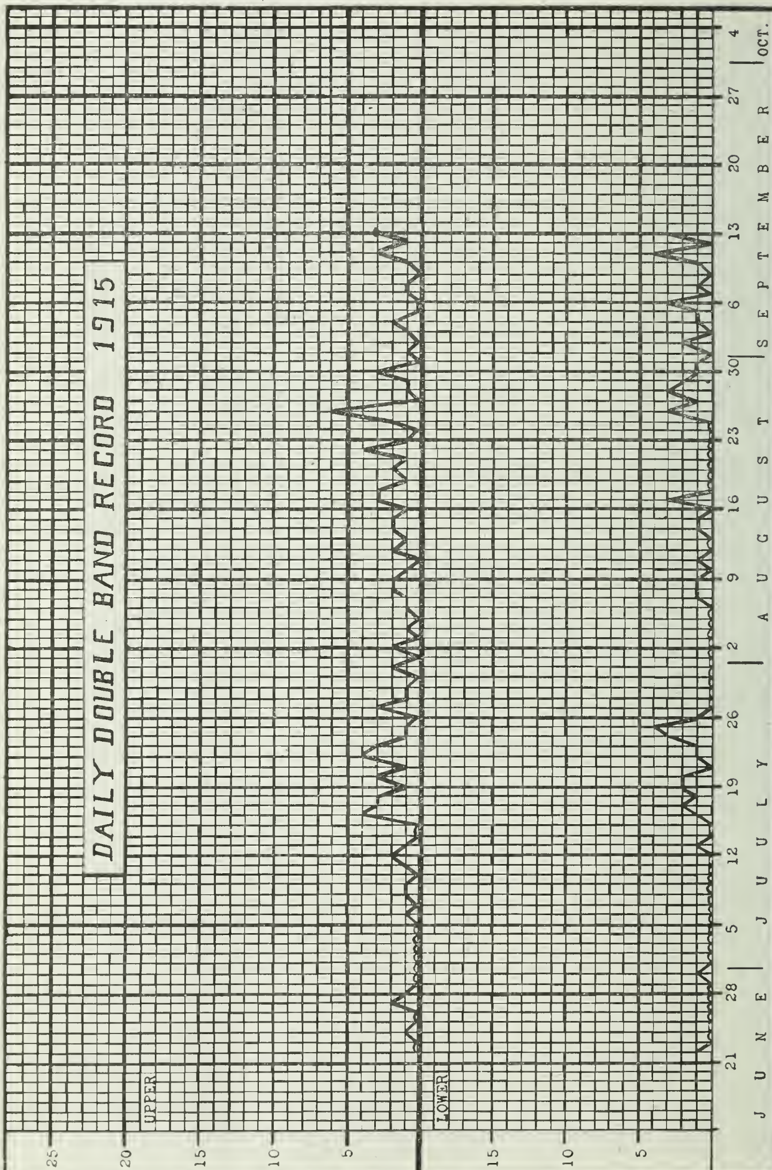
DAILY DOUBLE BAND RECORD 1915
UPPER
LOWER
25 20 15 10 5
15 10 5
21 28 5 12 19 26 2 9 16 23 30 6 13 20 27 4
JUNE
JULY
AUGUST
SEPTEMBER
OCT.

Fig. 19.

and 14. These curves are very similar, but the maximum of the lower curve comes about three weeks later than that of the upper. The total number of larvae were 294, which is 2 less than for the upper, and averages 1.92 larva per day.

1915.

Three trees were banded. The upper curve is exceedingly small, only reaching the five line once. It has a total of 105 larvae, which averages about 1.25 larva per day.

The lower curve is correspondingly small and has a total of only 57 larvae. This is an average of about .6 of a larva per day.

For the five years this work was run there were captured 2502 larvae under the upper bands and 1890 under the lower bands. This shows that 1.32 times as many larvae were captured under the upper bands; but all of those reaching the ground may not have found the lower bands.

WEEKLY AND THREE-DAY OBSERVATIONS.

Each year a number of trees were banded and observed only once a week, from 1910 to 1916, inclusive. Some years these were in the same orchards as the other bands and some years they were in different ones. The data from these observations were collected, and from them curves plotted and studied carefully. It was found that they did not bring out any features that were not clearly shown by the daily life curves; in fact, the daily life curves brought out every feature more clearly than the weekly. For this reason it was decided not to use the curves in this bulletin. However, the data were used in working out ''Banding as a Control Measure'' for the years 1913, 1914 and 1915.

The Three-Day observations were carried on for four years, 1913 to 1916, inclusive. Curves were drawn

from the data collected for each year. They were omitted for the same reason the weeklies were left out.

DISCUSSION OF CURVES ON WINDFALLS, WORMY APPLES, AND WORMS IN APPLES.

In order to determine the per cent of larvae that fall to the ground with the apples and leave them later, two trees were selected and all windfall apples under them were cut into thin slices and examined for larvae, morning and evening, for the four years, 1911, 1912, 1913 and 1914.

An average of the total number of windfalls for the four years is represented by the lower curve and recorded as "Number of Windfall Apples." The averages of all those that were wormy are represented by the middle curve as "Number of Wormy Apples." The averages for those which had worms at the time of cutting are plotted in the upper curve as "Worms in Apples." These three curves are quite uniform throughout the season, as regards numbers represented.

The lower curve, representing the number of windfall apples, reaches a maximum of 79 on August 15. A total of 13,986 apples fell during the four years, or an average of 1623.25 per tree per year.

The curve representing the number of wormy apples corresponds very closely to the lower, except that it is represented by a smaller number of apples. There was a total of 7755 wormy apples, or an average of 969.36 per tree per year. (June 20 to 24 in the curve should be 24, 22, 11, 21, 10, 12, 11, instead of figures represented.)

The upper curve, showing the number of worms found in the apples when they were examined, is also very similar to the other two in shape, but is much smaller and is not quite so rugged. There was a total of 1545 worms found in apples,—an average of 193 per tree per year.

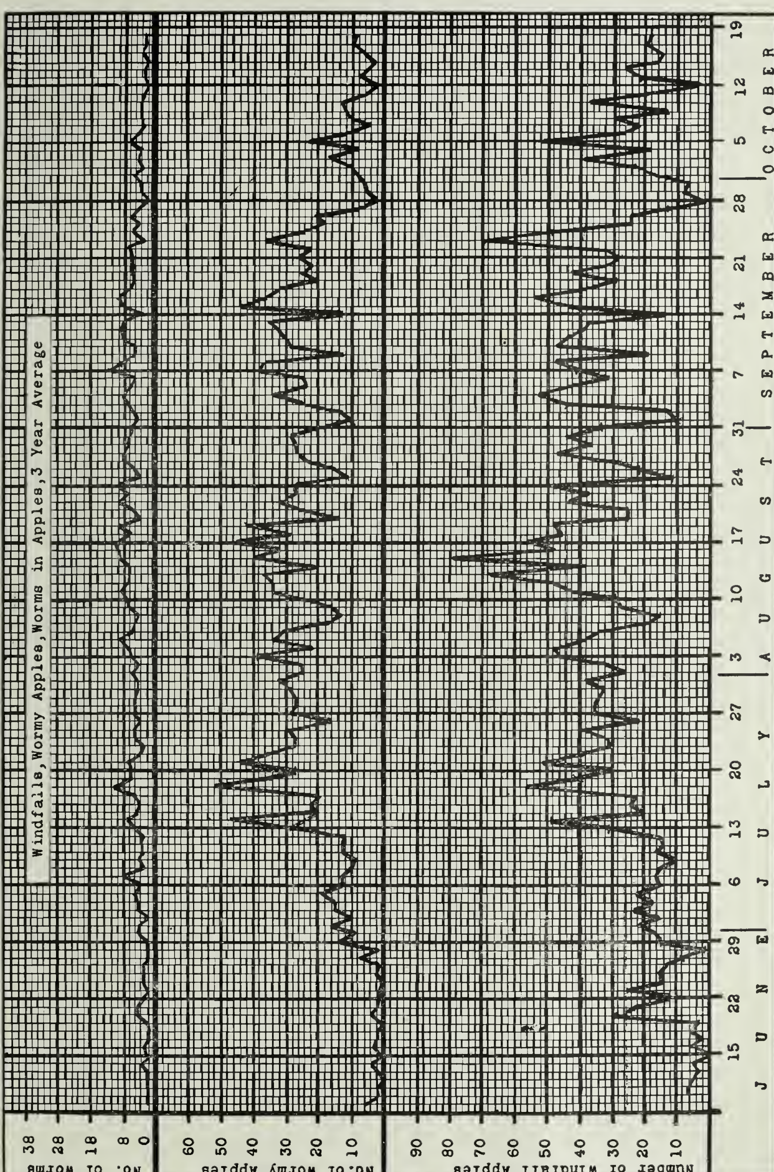

Fig. 20.

(Note.—The last part of the above title should read "4 year average," instead of 3 year.)

These curves show that of the 13,986 apples that fell during the four years, 55.4% were wormy, and 19.9% of these had worms in them when they fell. According to this, 80.1% of the worms leave the apples before they fall from the tree. Some orchardists practice running hogs in the orchard to keep the windfall apples picked up. This not only furnishes some food for the hogs, but if the apples are kept picked up clean by them it would destroy about 19.9% of the codling moth larvae.

BANDING AS A CONTROL MEASURE.

Many orchardists band their trees and consider it a practical method of aiding in the control of the codling moth. However, they often use old, rotten, dirty bands that catch very few larvae, and have them fastened to the tree in a manner which makes examination very slow; and in many cases the bands are neglected and the intervals between observations are so long that the bands serve only as a hiding place for the larvae to transform into moths.

It would not be necessary for the orchardist to examine the bands as often as was done in these experiments. Once every ten days should be often enough. Normally the codling moth larva remains about four days after it has hidden and spun its cocoon before it pupates, and about ten days as a pupa before the moth emerges. This gives about 14 days from the time the larva leaves the apple until it emerges as a moth. However, a few individuals will transform in a little less time.

Theoretical Results of Banding Trees*

Table 1 shows the results of the observations.

In order to determine the approximate number of codling moths destroyed by this band work, and the amount of apples saved, it is necessary to arrive at a

*(Computed from the data for the Weekly Bands for 1913, 1914, and 1915.)

theoretical estimate of what would have been their progeny in the subsequent broods. This, of course, is somewhat difficult, as one does not know where to stop or how to figure on the many factors which affect the existence of the moths from year to year. However, by using the "Average Daily Life Curve" as a basis for our computations, finding the ratio of each brood to the one following it and working our figures in the same ratio, the results should be quite accurate and conservative.

TABLE 1.—RECORD OF WEEKLY BAND OBSERVATIONS.

1913, 24 trees.			1914, 49 trees.			1915, 41 trees.		
Date Made	Time Required, Minutes	Number of Larvae	Date Made	Time Required, Minutes	Number of Larvae	Date Made	Time Required, Minutes	Number of Larvae
May 23	30	0	June 25	80	44	June 5	240	667
30	45	8	July 2	85	45	12	240	728
June 6	30	16	9	75	29	19	210	440
13	45	27	16	70	80	26	240	492
20	40	40	23	85	110	July 3	240	719
27	50	43	30	80	83	10	260	1113
July 4	40	55	Aug. 6	90	331	17	240	743
11	43	100	13	95	235	24	280	1650
18	45	114	20	100	393	31	235	665
25	43	108	27	95	345			
Aug. 1	45	122	Sept. 3	95	365		2185	7217
8	45	149	10	120	478			
15	46	143	17	90	235			
22	50	162	24	85	150			
29	52	173	Oct. 1	90	174			
Sept. 5	40	100	8	95	170			
12	40	73	15	80	103			
20	30	92	22	75	90			
27	30	73						
Oct. 4	35	74		1585	3460			
11	25	15						
18	23	18						
25	25	15						
	897	1720						

Dividing the season's larvae into four broods, as indicated by the "Average Daily Life Curve," Fig. 9, page 20, making the first brood end on July 1, the second on August 10, the third on September 13, and the fourth finishing the season, then determining the progeny of

each brood, should give the results of the year's band work.

Beginning with 1913, the data are quite complete. Twenty-four trees were banded and a total of 1720 larvae caught. 134 of these belong to the first brood. By referring to the "Average Daily Life Curve" we find that the first brood is represented by 338 larvae and the second by 964, which is 2.85 times the number represented in the first brood. The third brood has 774 larvae, or .8 as many as the second brood. The fourth brood has 445 larvae, which is .57 as many as the third brood. The first brood has .76 as many as the fourth.

Multiplying the 134, representing the larvae caught in the first brood of 1913, by 2.85, gives 381.9; which would have been their progeny in the second generation. Then multiplying the 381.9, progeny of the second generation, by .8 gives 305.52 larvae, progeny in the third generation. And multiplying the 305.52 by .57 gives 174.14 progeny in the fourth generation. Continuing to the spring brood, to carry them through four broods, and multiplying the 174.14 by .76 gives 132.35 larvae, progeny in the spring brood of 1914. This would give as progeny of larvae caught in the first brood of 1913 a total of 993.91 larvae to enter apples. Continuing to the second brood of larvae caught in 1913 and figuring their progeny the same as for the first brood—multiplying first by .8, then by .57 and then by .76—would give a total of 1038.56 larvae which would have been the progeny of the second brood caught in 1913. There would have been 652.96 larvae resulting from the third brood caught in 1913 and 218.12 larvae from the fourth brood. This would give a total of 2,903.55 larvae that would have been the progeny of the larvae destroyed by the 1913 band work.

By dividing the larvae caught by 1914 and 1915 band work into four broods and computing their progeny in the same manner as for 1913, it would give a total of

4,194.99 larvae that were destroyed in 1914 and 27,945.69 larvae killed by 1915 band work. This makes a sum total of 35,044 larvae that would have been the progeny of the larvae destroyed by the three years' band work. Allowing two larvae to enter each apple—in order to be conservative—this would be a sufficient number to destroy 17,522 apples, or 175.22 boxes of a hundred to the box, amounting to $157.70, at 90c per box.

It took a total of 77.1 hours to make the band observations, at 15c, amounting to $11.56. The cloth for the bands cost about five cents each, making $5.70 for the 114 trees banded.

Cost of labor	$11.56
Cost of bands	5.70
Total	$17.26

From these figures we should be able to get some idea as to whether or not it is profitable to band trees as an aid in controlling the codling moth. In 1915 a total of 7,217 larvae were caught from 41 bands in 9 weeks, or an average of 19.6 larvae per tree per week. The observations took an average of about six and one half minutes per tree; or 3 larvae per minute were caught. This was in an unsprayed orchard.

Mr. E. H. Siegler of the Bureau of Entomology, United States Department of Agriculture, has devised a screen "trap band" to catch the moths and eliminate the necessity of examining the bands and destroying the larvae. This trap band is made as follows: Strips of burlap or cloth six inches wide are folded into three thicknesses. The loose bark from the lower branches and trunk of the tree is removed and a strip of this cloth placed once around the trunk. Two rows of large tacks are driven in the cloth band in such a way that the heads lack about

one-fourth of an inch of coming against the cloth. This is to hold the screen band up off of the cloth. The cloth band is then covered by black-painted wire screen with twelve meshes to the inch. The strip of screen should be long enough to allow for an overlap of three to four inches when placed around the trunk of the tree. The wire screen is placed over the cloth band and tacked to the tree in such a way that both the upper and lower edges fit snugly against the bark. To make sure that no moths escape through the openings along the edges of the trap or along the flap, a thin coating of pitch tar may be used. This may be applied readily with a brush. The traps may be placed on the trees at any time during the winter or in the spring, not later than one month after the petals have dropped. As long as no openings occur in them they will require no further attention. The codling moth larva, having completed its feeding in the fruit, seeks a place to spin its cocoon, and generally crawls to the trunk of the tree. Meeting the trap, it enters through one of the openings in the mesh of the wire screen and spins its cocoon beneath the cloth band. When it emerges as a moth its larger size makes it unable to escape through the opening in the screen by which it entered the trap.

It must be clearly understood, however, that this trap is not a substitute for spraying, but merely an additional method of destroying codling moths. Since we have only tried this trap during the season of 1917, no definite statement can be made at this time regarding its value in this State. However, there is no reason why it should not prove as successful for New Mexico as in the district where Mr. Siegler carried on his investigations; unless the codling moth in this southern district, where the life cycle is shorter and we have more broods, should be smaller in size; in which case a smaller meshed screen may have to be used.

NATURAL ENEMIES.

The following are the natural enemies which were noticed while making the observations:—

Larvae of the Clerid beetle which are most conspicuous during the spring. They seem to attack the codling moth larvae more while they are in hiding or cocooning places, such as under bark and bands, than at any other time.

Both the adult and the larval form of the Lace Wing. The larvae of the Lace Wing do not feed upon the codling moth so much under the bands as they do in the open. The adults feed in the open altogether.

The small red ants destroy a good many larvae, especially under the bands and other hiding places.

In addition to the above insect enemies several of the birds were noticed eating the larvae. Where hogs and chickens had access to the orchard, many larvae were destroyed by them; the hogs getting the larvae by eating the windfall apples.

TABLE 2.—DAILY BAND RECORD. TEMPERATURE AND PRECIPITATION.

DATE	1909				1910				1911				1912				1913				1914				1915			
	No. of Larvae	Maximum	Minimum	Precipitation, in inches	No. of Larvae	Maximum	Minimum	Precipitation, in inches	No. of Larvae	Maximum	Minimum	Precipitation, in inches	No. of Larvae	Maximum	Minimum	Precipitation, in inches	No. of Larvae	Maximum	Minimum	Precipitation, in inches	No. of Larvae	Maximum	Minimum	Precipitation, in inches	No. of Larvae	Maximum	Minimum	Precipitation, in inches
May																												
15	—	—	—	—	—	—	—	—	5	84	43	0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
16	—	—	—	—	—	—	—	—	5	86	39	0	—	—	—	—	—	—	—	—	0	85	48	0	—	—	—	—
17	—	—	—	—	—	—	—	—	0	89	49.	0	—	—	—	—	—	—	—	—	0	89	47	0	—	—	—	—
18	—	—	—	—	—	—	—	—	5	88	46	0	—	—	—	—	—	—	—	—	0	87	54	0	—	—	—	—
19	—	—	—	—	—	—	—	—	5	86	54	0	—	—	—	—	—	—	—	—	0	86	64	.01	—	—	—	—
20	0	85	55	0	—	—	—	—	15	74	45	0	—	—	—	—	0	85	48	0	0	87	49	0	—	—	—	—
21	0	84	40	0	—	—	—	—	8	77	39	0	—	—	—	—	0	89	45	0	0	90	55	0	—	—	—	—
22	0	83	46	0	—	—	—	—	4	85	40	0	—	—	—	—	0	87	49	0	0	86	59	0	—	—	—	—
23	0	79	49	0	—	—	—	—	6	90	48	0	—	—	—	—	0	90	63	0	0	89	57	.10	—	—	—	—
24	0	75	52	T	—	—	—	—	10	93	59	0	—	—	—	—	0	90	59	0	0	86	54	0	—	—	—	—
25	0	74	43	0	—	—	—	—	2	92	60	T	—	—	—	—	0	91	55	0	0	89	55	0	—	—	—	—
26	0	85	40	0	5	90	53	0	10	86	60	0	—	—	—	—	0	95	55	0	0	93	52	0	—	—	—	—
27	0	91	44	0	7	95	57	0	3	87	47	0	—	—	—	—	2	91	63	.01	0	87	59	0	—	—	—	—
28	0	89	50	0	3	99	65	0	12	90	51	0	—	—	—	—	1	90	58	0	1	89	50	0	—	—	—	—
29	0	81	55	0	16	99	67	0	12	91	60	0	—	—	—	—	4	93	48	0	0	93	48	0	—	—	—	—
30	0	85	51	0	16	94	66	0	8	96	57	0	—	—	—	—	3	93	48	0	0	79	60	.04	—	—	—	—
31	0	84	49	0	19	95	64	T	12	94	65	.03	—	—	—	—	4	94	53	0	0	76	59	.12	—	—	—	—
June																												
1	0	87	50	0	10	95	60	0	11	94	56	0	—	—	—	—	1	93	57	0	0	83	53	.58	4	94	62	0
2	0	92	54	0	13	92	60	0	12	92	65	0	—	—	—	—	2	92	56	.01	0	85	53	0	46	89	57	0
3	0	95	71	0	22	89	66	0	10	93	61	0	—	—	—	—	4	93	59	0	0	89	59	0	43	86	59	0
4	0	97	57	0	14	93	62	0	5	95	53	0	—	—	—	—	2	89	68	0	0	90	56	0	51	83	58	0
5	0	97	57	0	5	98	59	0	8	98	62	0	—	—	—	—	1	89	49	0	1	89	54	0	27	85	48	0
6	0	95	67	0	10	97	61	0	8	98	54	0	—	—	—	—	3	89	55	0	0	89	59	0	29	90	53	0
7	0	95	60	0	7	97	59	0	9	97	64	0	13	89	68	0	2	85	65	.77	0	89	54	0	28	80	56	0
8	0	92	61	0	12	101	61	0	4	95	62	0	10	91	64	.01	5	82	48	.01	1	87	61	0	46	90	50	0
9	0	93	48	0	7	103	59	0	21	96	65	0	10	95	69	0	6	85	55	.36	0	91	64	0	27	95	56	0
10	0	93	48	0	15	93	65	0	11	94	61	0	16	91	63	T	2	87	60	0	0	81	63	.37	29	97	56	0
11	0	94	49	0	8	87	66	0	17	73	63	.04	21	84	64	0	3	86	55	0	0	90	60	0	39	94	60	0
12	0	93	49	0	5	99	60	0	4	71	61	0	22	87	59	0	6	89	59	0	2	95	63	0	11	95	50	0
13	0	95	56	0	17	99	63	0	6	79	58	.23	10	90	56	0	7	93	53	0	0	95	64	0	19	93	55	0
14	0	96	54	0	5	97	74	0	3	85	60	0	14	93	59	0	9	94	63	0	3	95	66	.15	—	95	48	0
15	0	95	71	0	8	98	67	0	6	91	56	0	11	94	59	0	9	92	63	.55	1	87	63	0	—	99	55	0
16	0	97	67	0	12	94	62	0	3	93	59	0	16	93	60	0	2	88	60	0	0	95	66	0	—	100	62	0

TABLE 2 (Cont'd).—DAILY BAND RECORD, TEMPERATURE AND PRECIPITATION.

DATE	1909				1910				1911				1912				1913				1914				1915			
	No. of Larvae	Maximum	Minimum	Precipitation, in inches	No. of Larvae	Maximum	Minimum	Precipitation, in inches	No. of Larvae	Maximum	Minimum	Precipitation, in inches	No. of Larvae	Maximum	Minimum	Precipitation, in inches	No. of Larvae	Maximum	Minimum	Precipitation, in inches	No. of Larvae	Maximum	Minimum	Precipitation, in inches	No. of Larvae	Maximum	Minimum	Precipitation, in inches
17	0	99	65	0	5	99	52	0	10	94	57	0	21	92	60	0	5	86	62	0	2	80	67	.66	—	99	62	0
18	0	99	66	0	11	102	52	0	9	95	54	0	6	80	52	0	3	88	62	.15	0	89	65	0	—	101	60	0
19	0	93	62	.55	6	103	63	0	9	96	62	0	11	83	55	0	1	89	61	.06	1	90	67	0	43	101	56	0
20	0	95	66	0	12	100	61	0	4	83	65	.03	12	87	67	T	3	89	60	0	1	94	69	0	27	102	54	0
21	0	98	58	0	21	99	65	0	2	98	63	0	6	92	53	T	4	86	64	.18	4	93	62	0	24	104	54	0
22	0	99	61	0	10	97	68	0	2	91	63	.03	4	94	63	.10	3	85	62	0	1	95	53	0	24	102	64	T
23	0	95	71	0	11	92	71	0	1	97	64	0	9	92	61	.01	5	87	60	.54	1	93	67	0	32	101	72	0
24	0	99	65	0	9	93	60	0	3	100	57	0	9	86	62	T	3	90	61	0	1	91	65	0	29	101	65	0
25	0	98	68	T	13	85	63	.25	4	101	60	0	13	92	58	T	5	92	61	0	1	93	63	0	21	95	66	T
26	0	95	61	0	4	80	64	0	4	100	59	0	9	92	61	T	6	94	58	0	0	94	65	.09	18	98	57	0
27	0	98	71	0	9	85	64	0	4	102	61	0	5	91	60	T	3	94	67	0	1	100	64	0	16	99	58	0
28	0	96	68	T	10	89	64	0	1	98	62	0	8	95	68	0	35	92	73	0	2	98	65	0	22	102	56	0
29	0	96	70	0	6	93	66	0	2	93	67	0	5	94	65	T	13	94	65	0	0	101	65	0	33	100	58	0
30	0	93	68	T	6	88	61	0	1	92	66	0	6	95	64	0	32	96	64	0	0	97	73	T	25	100	70	0
July																												
1	0	90	64	T	10	101	61	0	2	84	66	.25	11	94	67	T	12	97	61	0	1	89	70	.27	23	102	67	T
2	0	91	74	0	10	102	58	0	3	89	64	.02	9	96	64	.05	19	95	65	0	0	86	62	0	21	97	68	T
3	0	94	71	.48	0	103	64	0	4	89	65	0	5	92	62	0	15	98	66	0	1	84	64	T	43	98	62	0
4	0	90	68	0	38	102	60	0	6	91	66	0	3	87	66	0	15	99	66	0	0	87	65	0	43	93	68	0
5	0	92	68	0	14	102	77	0	19	88	63	0	6	90	51	0	18	99	65	T	1	93	60	0	57	94	67	T
6	0	90	62	0	19	101	78	0	7	82	66	.11	5	96	52	0	17	96	64	T	3	95	60	.32	53	99	64	0
7	0	98	69	0	20	98	70	0	16	86	66	0	5	98	63	0	37	96	69	0	3	92	62	.40	104	99	55	0
8	0	97	67	0	35	104	68	0	21	88	67	0	10	100	63	0	20	101	66	0	1	87	63	0	91	103	65	0
9	0	99	68	0	27	104	73	0	8	89	67	.27	19	98	62	0	16	99	65	0	4	90	61	0	89	105	68	0
10	0	102	72	0	24	96	65	.60	30	82	65	.30	14	100	60	.01	25	100	69	0	2	91	66	0	75	103	65	0
11	0	104	73	0	41	89	61	0	5	89	64	0	16	98	67	0	25	104	69	0	10	92	66	T	96	102	67	.25
12	0	106	67	0	41	92	63	0	8	91	66	0	39	99	73	0	24	102	73	0	8	93	65	0	75	95	68	0
13	0	101	68	0	30	90	69	0	7	92	67	.06	16	96	71	0	35	101	73	.50	3	93	65	0	77	100	64	T
14	0	99	65	0	38	93	69	.08	13	86	68	.10	18	93	73	0	14	92	62	0	10	94	65	0	—	99	69	0
15	0	97	68	T	14	92	69	0	14	92	69	.10	33	93	65	.01	28	92	67	T	9	94	62	0	—	93	67	.06
16	0	95	69	.01	33	92	68	.14	4	91	67	0	14	92	68	0	8	94	69	.02	3	92	68	.19	—	93	67	T
17	0	97	69	0	22	95	64	0	9	91	61	0	41	94	64	T	21	92	60	T	2	94	68	.05	—	92	69	0
18	0	95	68	0	36	97	60	0	17	93	68	0	26	91	70	0	34	92	65	T	3	94	64	.06	104	94	67	0
19	0	92	64	0	28	98	64	0	16	88	69	0	27	92	70	0	20	91	63	0	2	92	64	.56	93	97	68	.38
20	0	92	66	.04	51	99	65	0	11	91	71	0	43	96	67	T	21	89	63	T	3	91	64	0	68	90	64	0

TABLE 2 (Cont'd).—DAILY BAND RECORD, TEMPERATURE AND PRECIPITATION.

DATE	1909				1910				1911				1912				1913				1914				1915			
	No. of Larvae	Maximum	Minimum	Precipitation, in inches	No. of Larvae	Maximum	Minimum	Precipitation, in inches	No. of Larvae	Maximum	Minimum	Precipitation, in inches	No. of Larvae	Maximum	Minimum	Precipitation, in inches	No. of Larvae	Maximum	Minimum	Precipitation, in inches	No. of Larvae	Maximum	Minimum	Precipitation, in inches	No. of Larvae	Maximum	Minimum	Precipitation, in inches
21	0	91	69	0	43	97	72	0	22	96	68	0	39	94	72	.01	43	76	65	.62	4	87	65	0	122	90	67	0
22	0	94	67	0	53	97	72	0	12	93	64	0	9	91	66	0	16	83	60	0	4	90	63	.05	128	90	65	0
23	3	84	68	.09	54	97	67	0	24	95	65	0	22	84	67	.16	15	89	56	0	9	85	65	.09	135	92	67	T
24	0	86	66	0	46	97	68	0	32	80	72	0	29	92	65	.11	16	92	53	0	3	90	63	0	92	89	68	.06
25	0	93	69	.01	63	97	70	0	21	85	60	0	34	91	66	.05	15	92	58	0	1	90	65	0	82	86	66	.49
26	0	93	69	0	52	100	71	0	30	91	65	0	27	92	60	0	18	93	57	0	4	91	63	0	37	87	65	0
27	1	93	66	0	37	96	68	.28	22	87	64	.15	22	92	63	0	19	92	57	0	15	91	64	.04	55	88	66	T
28	2	96	64	0	34	96	66	0	15	92	67	0	14	94	68	.07	24	91	60	0	14	90	66	.05	66	88	66	T
29	0	95	71	0	32	98	71	0	18	95	68	0	20	94	68	.01	23	90	66	0	8	90	66	0	51	89	66	0
30	0	93	63	0	58	98	65	0	23	97	72	0	18	96	66	0	18	91	60	.13	4	94	63	0	61	95	61	T
31	0	96	70	.08	37	99	68	0	19	98	66	0	18	98	66	0	20	90	60	0	6	95	63	0	55	97	60	0
Aug.																	15	90	57	.27	4	98	63	0	56	97	60	0
1	1	96	69	0	53	100	69	0	15	100	60	0	14	98	65	0												
2	0	95	64	0	26	102	71	0	21	96	56	0	18	97	69	.13	14	90	59	0	3	98	65	T	42	94	61	T
3	1	96	63	0	50	101	70	0	22	96	63	0	15	96	67	0	9	93	59	0	9	90	70	0	16	90	59	0
4	0	93	66	0	40	96	74	.61	27	98	62	0	12	93	69	.20	17	91	59	.02	11	93	65	0	—	93	62	0
5	4	95	65	0	17	93	66	0	10	99	56	0	13	92	64	0	12	94	63	.08	7	94	62	0	—	82	65	.13
6	1	96	65	0	27	95	67	0	20	100	56	0	18	97	66	T	13	95	64	0	7	95	63	0	—	80	64	1.03
7	0	96	60	0	32	94	66	.03	7	103	62	0	21	99	65	0	15	95	65	0	12	94	69	0	—	82	62	T
8	0	92	67	0	53	97	73	0	14	101	63	0	29	100	60	0	17	92	63	0	9	96	63	0	—	90	58	0
9	0	91	61	T	30	94	67	0	15	99	66	0	22	99	65	0	21	94	67	0	2	97	64	.04	18	90	64	0
10	0	92	68	T	48	89	65	.45	13	99	64	0	17	99	64	0	15	95	69	.01	16	97	66	.04	17	88	61	0
11	0	94	72	0	46	95	69	0	15	96	65	0	25	94	69	0	50	93	67	.57	23	91	68	0	42	92	61	0
12	0	96	64	.10	49	95	69	0	15	95	65	0	19	92	56	.35	21	86	65	0	19	92	63	0	14	96	59	0
13	0	91	68	0	62	99	66	0	20	97	72	0	12	80	63	.01	6	82	62	T	14	95	62	0	7	92	57	0
14	1	92	67	.78	62	98	67	.01	16	101	69	0	13	83	65	0	7	89	60	0	11	93	63	0	20	90	59	0
15	0	91	66	0	79	90	69	0	19	99	68	0	12	80	62	.69	15	92	64	0	11	93	58	0	14	93	62	0
16	0	93	65	.06	62	93	71	0	13	99	70	0	9	86	62	.03	10	94	64	0	7	96	58	0	25	94	59	0
17	0	94	67	0	57	95	72	0	13	97	67	0	11	83	63	0	11	93	66	.11	10	98	59	0	49	95	82	0
18	0	92	67	0	53	89	70	0	24	98	73	0	28	84	64	.73	18	94	64	.07	22	98	61	0	55	94	61	0
19	0	94	66	0	49	89	68	.05	17	97	65	.09	10	75	62	.06	15	90	66	.01	13	95	60	0	66	95	63	0
20	0	95	64	0	54	93	66	0	9	98	68	0	15	84	65	.15	12	94	63	0	27	91	70	.39	61	96	64	0
21	0	95	62	0	52	100	66	0	19	96	74	0	14	78	65	0	18	93	64	0	23	93	65	.07	61	97	64	0
22	0	92	66	0	45	102	72	0	20	91	70	0	23	85	63	0	22	92	68	.03	15	89	62	0	61	96	66	0
23	0	91	69	0	68	100	73	0	5	87	65	0	27	85	63	.13	13	90	65	0	7	95	65	.05	70	97	63	T

TABLE 2 (Cont'd).—DAILY BAND RECORD, TEMPERATURE AND PRECIPITATION.

DATE	1909				1910				1911				1912				1913				1914				1915			
	No. of Larvae	Maximum	Minimum	Precipitation, in inches	No. of Larvae	Maximum	Minimum	Precipitation, in inches	No. of Larvae	Maximum	Minimum	Precipitation, in inches	No. of Larvae	Maximum	Minimum	Precipitation, in inches	No. of Larvae	Maximum	Minimum	Precipitation, in inches	No. of Larvae	Maximum	Minimum	Precipitation, in inches	No. of Larvae	Maximum	Minimum	Precipitation, in inches
24	0	90	68	0	55	102	72	0	15	90	63	0	20	85	65	0	9	92	67	0	7	93	64	.35	39	95	62	0
25	0	93	60	0	62	87	70	0	12	87	64	.05	12	84	59	1.14	10	93	63	.14	32	88	60	0	46	90	62	.01
26	0	93	62	0	72	90	62	0	12	84	62	0	25	89	68	0	6	91	58	0	21	89	60	0	51	90	60	T
27	0	92	65	0	73	97	64	0	9	91	62	0	31	88	65	.98	10	93	57	0	12	93	66	0	22	87	66	.04
28	0	84	72	0	76	99	65	0	14	85	60	0	19	87	64	0	3	90	62	.03	18	95	61	0	22	74	62	.11
29	0	83	65	.17	102	96	68	.31	19	86	58	0	30	88	65	.01	14	88	61	0	22	90	66	.54	17	76	62	0
30	1	86	66	0	43	84	61	0	17	90	60	0	37	85	62	0	11	89	60	0	12	82	61	0	20	82	53	0
31	0	91	60	0	71	88	62	T	17	92	62	0	64	82	65	.43	7	88	63	.10	23	87	62	0	20	86	50	0
Sept.																												
1	1	93	60	0	88	90	64	0	21	90	58	0	12	80	64	.17	8	90	65	0	33	90	62	0	16	86	54	0
2	2	95	62	0	—	95	63	0	23	92	58	0	20	83	63	.04	9	81	63	.13	21	90	56	0	28	88	55	0
3	0	95	66	0	—	98	65	0	5	89	66	0	26	84	60	0	6	78	56	.12	19	88	64	.05	11	89	61	T
4	1	94	67	.01	—	93	70	0	21	91	66	0	29	85	63	0	5	76	56	.07	15	90	58	0	10	84	63	.31
5	1	90	67	.27	—	94	62	0	21	92	63	0	25	85	64	0	11	75	61	.13	18	94	58	0	10	88	58	0
6	2	85	64	0	—	95	62	0	19	91	65	0	25	89	55	0	6	81	56	0	16	94	59	.06	13	91	54	0
7	3	85	66	0	—	93	62	0	17	90	63	0	21	87	58	0	8	83	57	0	—	95	58	0	10	93	53	0
8	3	91	67	.51	—	95	62	0	18	90	64	0	18	88	57	0	4	82	63	0	—	94	59	0	17	93	52	0
9	7	89	63	0	—	92	64	0	14	79	65	.88	29	85	59	0	2	87	62	0	—	99	62	0	7	93	46	0
10	8	89	63	.12	—	94	60	0	10	89	63	0	34	84	55	0	1	88	67	.34	—	93	67	.51	4	94	50	0
11	2	85	63	0	—	95	61	0	14	92	63	0	33	79	65	.01	15	86	60	0	—	90	64	T	15	96	48	0
12	4	86	64	0	—	93	55	0	15	92	66	0	2	74	61	.40	12	82	56	0	—	87	64	0	10	94	53	0
13	2	87	55	0	—	84	64	0	17	90	64	0	22	83	56	0	5	77	45	0	30	87	64	0	7	88	64	T
14	3	81	57	0	—	83	63	0	29	91	66	T	19	85	51	0	3	88	40	0	22	86	60	0	10	84	55	.02
15	5	80	52	0	—	78	68	0	25	91	62	0	14	86	50	0	2	87	41	0	30	80	62	.05	15	86	53	0
16	5	79	53	0	—	74	61	.23	23	92	66	0	6	85	57	0	9	88	45	0	5	89	51	0	9	87	63	T
17	9	81	52	0	—	83	61	0	25	92	64	.03	23	87	56	0	13	82	50	0	9	88	58	.03	9	85	60	.82
18	6	86	56	0	63	89	59	0	7	86	55	.17	47	88	54	0	4	87	49	0	15	85	60	0	—	—	—	—
19	12	89	50	0	36	90	59	0	15	77	56	0	36	92	49	0	6	95	46	0	7	87	62	.22	—	—	—	—
20	5	90	51	0	30	91	60	0	16	82	53	0	38	91	52	0	10	80	54	0	10	84	57	0	—	—	—	—
21	5	90	55	0	28	93	57	0	13	88	50	0	25	75	53	0	3	88	41	0	6	89	60	0	—	—	—	—
22	7	88	55	0	53	93	69	0	18	90	50	0	29	79	46	0	2	87	48	.12	10	88	54	0	—	—	—	—
23	12	84	51	0	35	94	56	0	9	93	52	0	24	85	44	0	3	84	6	0	6	82	60	0	—	—	—	—
24	12	84	54	0	—	94	55	0	17	95	54	0	39	85	46	0	1	66	57	.02	12	85	50	0	—	—	—	—
25	11	85	53	0	56	89	69	0	20	93	57	0	23	76	50	0	—	69	46	.34	9	83	44	0	—	—	—	—
26	11	77	51	0	43	90	64	0	8	93	60	0	19	82	44	0	2	53	44	.43	14	84	45	0	—	—	—	—
27	5	88	46	0	27	88	56	0	10	92	59	0	22	82	45	0	3	65	46	0	9	86	44	0	—	—	—	—

TABLE 2 (Cont'd).—DAILY BAND RECORD, TEMPERATURE AND PRECIPITATION.

	1909				1910				1911				1912				1913				1914				1915			
DATE	No. of Larvae	Maximum	Minimum	Precipitation, in inches	No. of Larvae	Maximum	Minimum	Precipitation, in inches	No. of Larvae	Maximum	Minimum	Precipitation, in inches	No. of Larvae	Maximum	Minimum	Precipitation, in inches	No. of Larvae	Maximum	Minimum	Precipitation, in inches	No. of Larvae	Maximum	Minimum	Precipitation, in inches	No. of Larvae	Maximum	Minimum	Precipitation, in inches
28	7	79	44	0	53	87	60	0	18	90	58	0	15	82	46	0	1	77	37	0	1	88	46	0	—	—	—	—
29	4	87	40	0	43	88	53	0	20	86	59	.06	17	71	50	0	—	80	40	0	11	84	52	0	—	—	—	—
30	8	79	49	.01	—	90	48	0	10	83	84	.04	14	83	56	.08	3	88	45	0	12	85	50	0	—	—	—	—
Oct.																	0	83	47	0	7	88	46	0	—	—	—	—
1	8	90	54	.05	—	—	—	—	9	89	65	0	2	61	53	.35												
2	19	86	54	0	—	—	—	—	8	89	61	0	27	74	47	0	1	80	59	0	1	87	49	0	—	—	—	—
3	15	84	58	.11	—	—	—	—	7	86	51	0	29	80	53	0	2	82	58	0	0	73	60	T	—	—	—	—
4	16	85	59	0	—	—	—	—	11	83	56	.12	20	81	51	T	3	77	48	0	4	78	52	0	—	—	—	—
5	20	85	55	0	—	—	—	—	19	74	53	.08	15	77	52	0	2	78	43	0	5	80	46	0	—	—	—	—
6	20	85	61	.02	—	—	—	—	4	74	45	0	21	80	44	0	2	78	50	0	3	82	47	0	—	—	—	—
7	7	75	57	0	—	—	—	—	10	74	44	0	17	72	49	.18	1	81	40	0	7	83	42	0	—	—	—	—
8	10	75	45	0	—	—	—	—	3	71	43	0	21	76	57	.14	0	83	43	0	3	79	51	0	—	—	—	—
9	2	65	38	0	—	—	—	—	1	73	38	0	17	78	45	0	1	80	46	0	8	85	42	0	—	—	—	—
10	5	75	30	0	—	—	—	—	6	79	48	0	12	73	46	0	4	77	51	0	0	86	40	0	—	—	—	—
11	6	81	35	0	—	—	—	—	—	—	—	—	11	71	42	0	0	80	45	0	0	88	41	0	—	—	—	—
12	6	87	42	0	—	—	—	—	—	—	—	—	0	64	45	.16	1	83	48	0	8	79	39	0	—	—	—	—
13	3	87	40	0	—	—	—	—	—	—	—	—	22	63	43	0	1	84	53	0	2	79	39	0	—	—	—	—
14	3	87	40	0	—	—	—	—	—	—	—	—	4	61	47	.14	1	86	55	0	4	76	35	0	—	—	—	—
15	10	88	37	0	—	—	—	—	—	—	—	—	14	70	41	0	0	72	51	0	4	80	36	0	—	—	—	—
16	9	88	44	0	—	—	—	—	—	—	—	—	14	72	36	0	0	78	45	0	5	78	34	0	—	—	—	—
17	1	75	57	0	—	—	—	—	—	—	—	—	3	77	36	0	0	79	34	0	6	82	40	0	—	—	—	—
18	2	67	49	0	—	—	—	—	—	—	—	—	20	80	39	0	0	76	41	0	6	80	40	0	—	—	—	—
19	4	69	35	0	—	—	—	—	—	—	—	—	—	—	—	—	0	72	41	0	3	77	41	.03	—	—	—	—
20	8	88	35	0	—	—	—	—	—	—	—	—	—	—	—	—	2	74	34	0	7	70	53	.11	—	—	—	—
21	2	85	42	0	—	—	—	—	—	—	—	—	—	—	—	—	5	79	33	0	2	71	48	.09	—	—	—	—
22	7	87	43	0	—	—	—	—	—	—	—	—	—	—	—	—	2	76	55	0	—	—	—	—	—	—	—	—
23	5	73	50	0	—	—	—	—	—	—	—	—	—	—	—	—	12	80	34	0	—	—	—	—	—	—	—	—
24	1	85	37	0	—	—	—	—	—	—	—	—	—	—	—	—	11	80	36	0	—	—	—	—	—	—	—	—
25	2	75	35	0	—	—	—	—	—	—	—	—	—	—	—	—	6	84	35	0	—	—	—	—	—	—	—	—
26	—	82	33	0	—	—	—	—	—	—	—	—	—	—	—	—	4	61	39	0	—	—	—	—	—	—	—	—
27	—	83	35	0	—	—	—	—	—	—	—	—	—	—	—	—	—	68	25	T	—	—	—	—	—	—	—	—
28	—	83	35	0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
29	—	82	36	0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
30	—	79	38	0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
31	—	71	44	0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

TABLE 3.—MORNING AND EVENING BAND RECORDS FOR THE YEARS 1911, 1912, 1913 AND 1914.

Date	No. of Larvae 1911		No. of Larvae 1912		No. of Larvae 1913		No. of Larvae 1914	
	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening
May								
15	—	5	—	—	—	—	0	0
16	—	5	—	—	—	—	0	0
17	—	0	—	—	—	—	0	0
18	—	5	—	—	—	—	0	0
19	—	5	—	—	—	—	0	0
20	11	4	—	—	0	0	0	0
21	8	0	—	—	0	0	0	0
22	0	4	—	—	0	0	0	0
23	3	3	—	—	0	0	0	0
24	2	8	—	—	0	0	0	0
25	0	2	—	—	0	0	0	0
26	4	6	—	—	0	0	0	0
27	1	2	—	—	1	1	0	0
28	5	12	—	—	0	1	1	0
29	11	1	—	—	4	0	1	0
30	4	4	—	—	1	2	0	0
31	11	1	—	—	1	3	0	0
June								
1	9	2	—	—	1	0	0	0
2	11	1	—	—	2	0	0	0
3	8	2	—	—	4	0	0	0
4	5	0	—	—	2	0	0	0
5	8	0	—	—	1	0	0	0
6	7	1	—	—	1	2	0	0
7	8	1	13	—	1	1	0	1
8	4	0	10	—	4	1	0	0
9	21	0	10	—	6	0	0	0
10	11	0	16	—	1	1	0	1
11	11	6	17	4	1	2	0	0
12	3	1	21	1	5	1	0	0
13	4	2	10	0	5	2	0	0
14	3	0	9	5	6	3	2	0
15	2	4	3	8	8	1	0	0
16	3	0	14	2	1	1	2	1
17	8	2	19	2	3	2	1	0
18	5	4	5	1	3	0	0	0
19	7	2	6	5	1	0	1	1
20	3	1	10	2	3	0	0	0
21	1	1	5	0	4	0	1	0
22	1	1	9	0	3	0	0	1
23	1	0	7	2	5	0	3	0
24	2	1	9	0	3	0	0	1
25	2	2	11	2	2	3	1	0
26	3	1	8	1	3	3	0	1
27	2	2	3	2	3	0	1	0
28	1	0	7	1	15	0	0	0
29	2	0	5	1	11	2	1	0
30	0	1	6	0	9	1	1	1
July								
1	2	0	10	1	10	2	0	0
2	2	1	8	1	17	2	0	0
3	2	2	5	0	15	0	0	1
4	6	0	2	1	12	3	0	0
5	15	4	4	2	15	3	0	1
6	6	1	5	0	14	3	1	0
7	14	2	1	4	25	12	1	0
8	20	1	9	1	8	12	2	1
9	8	5	15	4	12	4	2	1
10	30	0	12	2	18	7	1	0
11	5	0	14	2	21	4	2	2
12	8	0	28	11	18	6	1	1
13	7	0	14	2	25	10	7	3
14	11	2	18	0	10	4	6	2

TABLE 3 (CONTINUED).—MORNING AND EVENING BAND RECORDS FOR THE YEARS 1911, 1912, 1913 AND 1914.

Date	No. of Larvae 1911		No. of Larvae 1912		No. of Larvae 1913		No. of Larvae 1914	
	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening
15	13	1	27	6	12	16	3	0
16	4	0	11	3	6	2	10	0
17	9	0	38	3	15	6	7	2
18	14	3	18	8	18	16	3	0
19	16	0	24	3	14	6	2	0
20	11	0	39	4	10	11	3	0
21	21	1	29	10	39	4	2	0
22	11	1	9	—	12	4	0	3
23	21	2	20	3	5	10	3	1
24	32	0	23	6	15	1	4	0
25	20	1	24	10	9	6	9	0
26	25	5	23	4	17	1	3	0
27	19	3	14	7	16	3	1	0
28	12	3	3	11	22	2	3	1
29	15	3	15	5	21	2	15	—
30	18	5	10	8	17	1	13	1
31	18	1	15	3	20	0	3	5
Aug.								
1	15	0	9	5	8	7	4	0
2	21	0	13	5	11	2	3	3
3	19	3	14	1	5	4	3	1
4	26	1	12	0	13	4	2	1
5	10	0	9	4	8	4	0	9
6	16	4	18	0	10	3	10	1
7	7	0	19	2	15	0	7	0
8	13	1	25	4	14	3	5	2
9	6	9	22	0	17	4	12	0
10	10	3	17	0	8	7	8	1
11	12	3	14	11	38	12	1	1
12	6	9	16	3	19	2	13	3
13	20	0	7	5	5	1	20	3
14	15	1	10	3	4	3	16	3
15	19	0	8	4	14	1	11	3
16	11	2	3	3	5	5	11	0
17	10	3	10	1	8	3	11	0
18	22	2	12	16	16	2	5	2
19	17	0	9	1	12	3	—	10
20	6	3	11	4	10	2	18	4
21	13	6	—	14	17	1	9	4
22	14	6	19	4	22	0	26	1
23	4	1	25	2	11	2	21	2
24	13	2	16	4	5	4	15	—
25	10	2	—	12	9	1	3	4
26	10	2	22	3	6	0	6	1
27	7	2	29	2	6	4	19	13
28	9	5	16	3	2	1	21	0
29	18	1	29	1	11	3	11	1
30	13	4	32	5	11	0	13	5
31	11	6	34	30	5	2	22	0
Sept.								
1	15	6	0	12	5	3	6	6
2	23	0	18	2	6	3	23	0
3	5	0	22	4	6	0	20	13
4	18	3	25	4	1	4	18	3
5	17	4	26	9	10	1	18	1
6	17	2	22	3	4	2	13	2
7	15	2	—	21	6	2	17	1
8	15	3	18	—	4	0	15	1
9	—	3	28	1	1	1	12	3
10	8	2	14	20	1	0	11	1
11	13	1	32	1	6	9	8	2
12	14	1	—	2	6	6	—	—
13	16	1	23	—	4	1	—	—
14	26	3	19	—	2	1	—	—
15	23	2	9	5	2	0	—	—

TABLE 3 (CONTINUED).—MORNING AND EVENING BAND RECORDS FOR THE YEARS 1911, 1912, 1913 AND 1914.

Date	No. of Larvae 1911		No. of Larvae 1912		No. of Larvae 1913		No. of Larvae 1914	
	Morning	Evening	Morning	Evening	Morning	Evening	Morning	Evening
16	20	3	—	6	4	5	—	8
17	22	3	23	0	11	2	—	8
18	7	0	47	0	4	0	3	2
19	15	0	36	0	2	4	5	4
20	14	2	38	0	3	7	7	8
21	11	2	24	1	3	0	5	2
22	16	2	24	5	2	0	6	4
23	5	4	—	24	0	1	3	3
24	16	1	31	8	2	1	7	3
25	19	1	23	—	0	—	5	1
26	7	1	—	19	2	0	8	4
27	9	1	22	0	1	2	5	4
28	12	6	1	15	1	0	6	8
29	19	1	17	0	—	0	9	0
30	9	1	1	14	2	1	0	1
Oct.								
1	8	1	—	2	0	0	6	5
2	7	1	—	27	0	0	4	8
3	7	0	—	29	1	0	3	4
4	11	0	—	20	2	0	1	0
5	—	19	—	14	3	0	0	0
6	4	0	7	14	2	0	2	2
7	8	2	—	17	1	1	3	2
8	—	3	—	21	1	0	2	1
9	—	1	—	17	0	0	7	0
10	—	6	—	12	1	0	3	3
11	—	—	—	11	4	0	1	2
12	—	—	—	—	0	0	5	3
13	—	—	—	22	0	1	0	0
14	—	—	—	4	1	0	0	0
15	—	—	—	14	0	0	7	1
16	—	—	—	14	0	0	2	0
17	—	—	—	10	0	0	1	3
18	—	—	—	20	0	0	2	2
19	—	—	—	—	0	0	3	2
20	—	—	—	—	0	2	3	3
21	—	—	—	—	1	4	4	2
22	—	—	—	—	1	1	1	2
23	—	—	—	—	5	7	4	3
24	—	—	—	—	8	3	2	0
25	—	—	—	—	2	4	—	0
26	—	—	—	—	2	2	7	0

TABLE 4.—DAILY DOUBLE BAND RECORDS FOR 1911, 1912, 1913, 1914 AND 1915.

Date	No. of Larvae 1911		No. of Larvae 1912		No. of Larvae 1913		No. of Larvae 1914		No. of Larvae 1915	
May	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
20......	—	—	—	—	—	—	0	0	—	—
21......	—	—	—	—	—	—	0	0	—	—
22......	—	—	—	—	—	—	0	0	—	—
23......	—	—	—	—	—	—	0	0	—	—
24......	—	—	—	—	—	—	0	0	—	—
25......	—	—	—	—	0	0	0	0	—	—
26......	4	7	—	—	0	1	0	0	—	—
27......	1	4	—	—	0	0	0	0	—	—
28......	6	5	—	—	2	0	0	0	—	—
29......	8	6	—	—	1	0	0	0	—	—
30......	8	5	—	—	0	0	0	0	—	—
31......	3	7	—	—	0	0	0	0	—	—
June										
1......	6	7	—	—	0	0	0	0	—	—
2......	8	3	—	—	0	0	0	0	—	—
3......	12	5	—	—	0	0	0	0	—	—
4......	4	1	—	—	0	0	0	0	—	—
5......	8	7	—	—	0	0	0	0	—	—
6......	7	1	—	—	1	1	0	0	—	—
7......	8	3	—	—	0	0	0	0	—	—
8......	3	1	—	—	2	1	0	0	—	—
9......	16	4	—	—	1	0	0	1	—	—
10......	15	4	—	—	0	1	0	0	—	—
11......	13	4	14	0	3	1	0	0	—	—
12......	2	1	4	2	2	1	2	0	—	—
13......	5	2	8	0	2	1	2	0	—	—
14......	0	1	8	0	2	0	0	0	—	—
15......	2	2	8	0	0	0	0	0	—	—
16......	2	0	12	1	4	0	0	0	—	—
17......	8	3	18	1	1	0	0	1	—	—
18......	5	6	4	1	0	0	0	0	—	—
19......	11	2	6	0	1	0	1	0	—	—
20......	2	1	8	2	0	0	0	0	—	—
21......	3	0	4	0	0	0	1	2	—	—
22......	4	0	2	1	1	0	0	0	0	1
23......	1	0	7	1	3	0	0	0	0	0
24......	2	1	7	1	2	0	0	1	1	0
25......	3	2	6	1	1	0	0	0	0	0
26......	3	1	3	3	0	0	0	0	0	0
27......	4	0	1	1	3	4	0	1	2	0
28......	0	1	2	1	5	0	0	0	1	0
29......	1	0	3	1	4	0	0	0	0	0
30......	1	0	4	0	2	3	0	0	0	1
July										
1......	1	1	4	0	8	6	0	0	0	0
2......	2	0	4	1	6	0	0	0	0	0
3......	2	0	1	0	2	0	0	0	0	0
4......	3	0	1	1	4	1	0	0	0	0
5......	11	4	5	0	6	2	0	0	0	0
6......	2	2	2	0	7	4	0	1	1	0
7......	1	0	3	0	2	2	0	0	0	0
8......	12	1	6	2	3	2	0	0	1	0
9......	5	2	17	1	5	2	1	0	1	0
10......	12	4	10	2	2	5	0	0	0	0
11......	4	1	13	0	3	5	1	0	1	0
12......	5	2	21	3	7	2	2	0	2	0
13......	7	0	12	3	1	0	0	0	1	1
14......	6	3	8	3	5	6	1	0	0	0
15......	10	2	23	3	2	0	3	0	0	0
16......	4	0	4	4	7	1	0	0	4	1
17......	7	1	29	4	0	1	1	0	3	2
18......	9	0	15	4	2	3	2	0	3	1
19......	8	0	16	3	6	3	0	0	1	2
20......	9	1	23	11	12	7	1	1	3	2
21......	10	2	14	8	0	1	1	0	1	1

TABLE 4 (Continued).—DAILY DOUBLE BAND RECORDS FOR 1911, 1912, 1913, 1914 AND 1915.

Date	No. of Larvae 1911		No. of Larvae 1912		No. of Larvae 1913		No. of Larvae 1914		No. of Larvae 1915	
	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
July										
22......	11	0	7	3	2	3	1	0	4	1
23......	19	1	11	1	3	5	2	1	3	1
24......	17	4	10	5	2	3	1	0	1	3
25......	13	3	20	4	5	3	0	0	1	4
26......	17	0	12	3	2	2	1	0	0	1
27......	10	3	3	3	5	5	5	0	3	0
28......	9	2	8	2	8	1	2	0	1	0
29......	14	2	9	0	2	4	3	1	1	0
30......	15	1	5	4	6	3	2	0	0	0
31......	12	1	7	1	4	4	3	0	2	0
August										
1......	8	3	6	2	2	2	3	0	0	0
2......	10	2	10	1	3	1	2	0	2	0
3......	11	5	9	1	0	4	1	0	0	0
4......	22	1	5	0	0	0	6	2	1	0
5......	5	1	4	1	2	4	1	0	0	0
6......	12	3	10	3	2	6	0	3	1	0
7......	5	0	7	4	3	4	7	1	1	1
8......	8	0	11	4	4	3	6	1	2	1
9......	4	0	11	4	2	11	1	0	2	1
10......	9	1	6	2	11	4	9	1	1	0
11......	6	3	6	3	6	1	5	3	0	1
12......	11	0	10	1	3	0	4	5	2	0
13......	8	4	5	3	2	4	4	3	1	0
14......	7	1	7	0	2	0	3	3	2	1
15......	12	3	4	4	2	4	3	2	2	1
16......	2	5	1	1	1	0	3	0	1	0
17......	6	3	2	2	7	3	2	0	3	3
18......	12	1	1	3	5	2	7	5	3	0
19......	8	3	5	3	7	2	3	3	1	0
20......	5	2	4	3	4	0	7	4	2	0
21......	3	11	4	2	6	3	8	3	1	0
22......	9	6	3	14	6	0	5	1	4	0
23......	3	2	15	5	0	0	0	2	1	0
24......	6	5	8	4	3	3	0	1	0	0
25......	4	3	1	3	1	3	5	6	2	0
26......	3	6	6	14	1	4	9	7	6	3
27......	4	4	9	14	1	7	3	3	0	1
28......	2	8	5	2	3	2	5	3	1	3
29......	5	9	7	15	1	5	8	6	1	2
30......	4	6	13	21	2	4	5	5	3	1
31......	5	9	8	21	1	3	6	6	0	1
Sept.										
1......	2	13	17	2	1	1	12	7	1	0
2......	8	12	9	8	1	3	7	8	0	2
3......	2	1	8	15	1	1	4	8	1	0
4......	9	8	5	17	0	1	6	5	2	1
5......	6	7	4	21	2	1	7	3	0	1
6......	7	9	10	9	2	1	5	3	0	3
7......	7	4	4	11	1	0	4	2	1	0
8......	11	2	3	14	0	2	—	—	1	1
9......	6	4	13	16	1	3	—	—	0	0
10......	3	2	0	14	3	1	—	—	1	1
11......	3	7	10	11	3	0	—	—	3	4
12......	8	4	4	9	0	0	3	5	1	0
13......	3	10	8	21	1	2	5	13	5	3
14......	4	17	9	2	0	0	6	13	—	—
15......	5	13	7	15	3	4	8	8	—	—
16......	9	8	10	33	4	5	0	0	—	—
17......	6	13	5	15	1	6	0	6	—	—
18......	1	2	7	27	0	2	3	8	—	—
19......	2	6	8	19	0	0	1	3	—	—
20......	3	5	9	24	1	0	2	4	—	—

TABLE 4 (Continued).—DAILY DOUBLE BAND RECORDS FOR 1911, 1912, 1913, 1914 AND 1915.

Date	No. of Larvae 1911		No. of Larvae 1912		No. of Larvae 1913		No. of Larvae 1914		No. of Larvae 1915	
	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower	Upper	Lower
Sept.										
21......	6	6	0	2	0	0	1	3	—	—
22......	7	8	9	21	0	0	0	6	—	—
23......	2	4	8	13	1	1	2	2	—	—
24......	4	5	19	26	0	1	1	4	—	—
25......	6	8	5	13	0	0	0	9	—	—
26......	4	2	9	8	0	0	1	12	—	—
27......	3	7	6	13	0	1	1	4	—	—
28......	6	8	3	9	0	0	0	0	—	—
29......	5	9	7	9	1	0	3	5	—	—
30......	2	7	1	0	0	1	5	6	—	—
Oct.										
1......	1	2	6	3	0	1	3	0	—	—
2......	0	4	2	6	0	1	0	1	—	—
3......	3	2	5	19	0	1	0	0	—	—
4......	3	4	5	11	0	0	2	0	—	—
5......	9	6	9	5	1	0	2	0	—	—
6......	1	3	8	13	0	0	1	1	—	—
7......	4	4	2	9	0	1	1	2	—	—
8......	1	1	3	8	0	3	3	2	—	—
9......	0	0	3	9	0	0	1	0	—	—
10......	1	2	4	7	0	1	4	3	—	—
11......	—	—	0	2	1	0	0	1	—	—
12......	—	—	—	—	0	0	0	2	—	—
13......	—	—	4	11	0	0	1	6	—	—
14......	—	—	0	1	0	0	0	1	—	—
15......	—	—	2	8	0	0	0	2	—	—
16......	—	—	3	9	0	0	2	1	—	—
17......	—	—	3	5	0	1	1	1	—	—
18......	—	—	1	13	0	2	0	5	—	—
19......	—	—	—	—	0	1	0	6	—	—
20......	—	—	—	—	0	3	0	3	—	—
21......	—	—	—	—	0	6	0	6	—	—
22......	—	—	—	—	0	1	—	—	—	—
23......	—	—	—	—	1	0	—	—	—	—
24......	—	—	—	—	6	0	—	—	—	—
25......	—	—	—	—	5	0	—	—	—	—
26......	—	—	—	—	0	0	—	—	—	—
27......	—	—	—	—	0	0	—	—	—	—
28......	—	—	—	—	0	—	—	—	—	—
29......	—	—	—	—	0	—	—	—	—	—
30......	—	—	—	—	0	—	—	—	—	—
31......	—	—	—	—	0	—	—	—	—	—

TABLE 5.—SHOWING THE AVERAGE NUMBER OF WINDFALLS, THE NUMBER OF THESE THAT WERE WORMY, AND THE NUMBER OF WORMY APPLES THAT HAD WORMS IN THEM AT THE TIME OF EXAMINATION. (Average for two trees for four years, 1911 to 1914, inclusive.)

Date	Windfalls	Wormy	No. of Worms	Date	Windfalls	Wormy	No. of Worms	Date	Windfalls	Wormy	No. of Worms	Date	Windfalls	Wormy	No. of Worms
June				12	15	12	1	15	79	40	10	18	29	20	4
9	25	5	0	13	31	29	4	16	47	32	10	19	42	25	5
10	6	1	0	14	49	47	7	17	56	45	11	20	32	22	5
11	6	2	0	15	20	20	3	18	45	29	6	21	27	26	5
12	5	0	0	16	24	22	2	19	47	42	10	22	32	22	6
13	3	1	0	17	22	19	4	20	25	14	2	23	70	36	1
14	5	4	2	18	56	52	11	21	25	25	5	24	49	24	5
15	0	0	0	19	40	36	5	22	43	32	10	25	24	18	3
16	6	3	1	20	30	27	5	23	37	27	7	26	24	21	6
17	2	2	0	21	51	44	7	24	48	27	11	27	13	8	3
18	6	2	0	22	39	35	4	25	11	11	2	28	2	2	0
19	3	0	0	23	30	27	2	26	21	16	4	29	8	5	2
20	29	24	3	24	31	27	4	27	28	23	8	30	6	6	2
21	23	22	3	25	39	29	4	28	47	26	8	Oct.			
22	12	11	1	26	21	16	2	29	36	27	7	1	17	8	5
23	25	21	0	27	35	29	4	30	44	28	6	2	23	10	2
24	14	10	1	28	35	27	4	31	33	19	5	3	39	17	3
25	15	12	1	29	34	27	4	Sept.				4	18	9	2
26	13	11	1	30	32	29	3	1	10	10	3	5	52	23	7
27	8	7	0	31	38	32	3	2	13	13	4	6	26	11	3
28	1	1	0	Aug.				3	44	25	6	7	22	4	1
29	15	14	0	1	26	24	5	4	52	34	8	8	30	11	2
30	16	9	3	2	32	25	3	5	42	23	5	9	13	12	2
July				3	46	39	5	6	31	22	4	10	37	13	2
1	21	16	2	4	48	21	6	7	41	39	13	11	19	5	1
2	15	10	0	5	38	34	9	8	47	37	9	12	3	1	0
3	23	15	3	6	33	31	5	9	19	13	4	13	21	7	1
4	17	15	3	7	19	17	4	10	47	29	4	14	25	5	1
5	22	19	4	8	15	13	3	11	44	30	8	15	16	3	0
6	15	13	2	9	27	16	6	12	39	32	9	16	15	6	2
7	16	13	8	10	29	24	7	13	37	35	8	17	19	10	1
8	15	10	1	11	42	34	9	14	14	13	2	18	18	9	1
9	10	9	2	12	48	34	7	15	44	44	9				
10	16	13	1	13	67	37	6	16	54	36	10				
11	14	13	2	14	38	20	6	17	39	32	6				

DISCUSSION OF TABLES 2, 3, 4, and 5.

Table 2 (pages 46, 47, 48, 49, 50), having the temperature and precipitation in columns by the side of the number of larvae captured, makes it easier to study the effect of temperature and rain on the movements of the larvae. Attention is called to the effects of the rain in the discussions of the daily life curves, but there is no mention of the temperature. This is because we feel that the influence of other factors is often greater than that of temperature, and consequently the effects expected from changes in temperature do not always show up distinctly. On the other hand, the effect of half an inch or more of rain is almost always noticeable either on the day it fell or the next.

Table 3 (pages 51, 52, 53), being tabulated in this form enables a comparison of the different years with greater ease than in the morning and evening curves, which are graphical representations of this table. The table shows a variation of the seasons for the different years; 1915 seeming to show a greater difference in the number captured morning and evening than any of the other years. This is especially true in July.

Table 4 (pages 54, 55, 56) is included so that a comparison of the different years may be more conveniently made. The discussion on the curves which were drawn from these figures covers the table to such an extent that it is not felt necessary to add anything here.

Table 5 (page 57) is an average of four years and gives a better idea than the yearly figures would have done of what might be expected for any particular year; as seasonal changes are not so noticeable.

SUMMARY.

1. From the work done at the beginning of these investigations in an effort to exterminate the codling

moth by destroying what apples remained after a severe killing spring frost, we would conclude that there is little likelihood that the insect will ever be permanently eradicated. It was also noticed that in three years after the destruction of the fruit crop the Valley was about as badly infested as before.

2. The effect of rain and temperature on the movement of the larvae was not so very pronounced, although on the whole there were fewer larvae caught immediately following a rain of any consequence or a decided drop in temperature.

3. More larvae per band were caught under the dark colored than under the light cloth.

4. From the morning and evening observations it was found that about three times as many larvae went under the bands at night as in the day time.

5. The Double-Band records show that 1.32 times as many larvae crawl down the trees and under the upper bands as were caught under the lower bands.

6. From the morning and evening observations for worms in windfallen apples it was found that 55.4 per cent of the windfalls were wormy and that 80.1 per cent of the worms left the apples before they fell from the trees and were examined.

7. It was estimated from the three years of weekly band records that $157.70 worth of apples were saved at a total cost of $17.26. In 1915 an average of 19.6 larvae were caught per tree per week.

8. The Average Daily Life Curve, made by combining the data for six of the daily life curves, indicated four broods of larvae. Consequently, there were four generations of codling moths. The overlapping of broods indicates different lengths of life cycles for individuals.

9. The first larvae were caught on May 18, with a maximum emerging in July and August.

10. The curves for the different years fluctuate

considerably but they show the relative distribution of the codling moth during the season.

11. These data show that it is difficult to control the codling moth. The maximum of larvae occur toward the middle of the season and there is a great overlapping of broods.

12. Although the curves show that there are four broods of larvae of the codling moth in this locality, many natural enemies were observed feeding on them.

Acknowledgments.

Acknowledgment is due Mr. J. E. Mundell, former Assistant in Horticulture, for helping with the investigations in 1907 and 1908. The writers feel especially indebted to Professor Fabian Garcia, who not only outlined the project and supervised the work, but gave valuable suggestions in preparing the manuscript.

B

BULLETIN No. 111

April, 1918

New Mexico College of Agriculture and Mechanic Arts

Agricultural Experiment Station
State College, N. M.

DAIRY COWS ON SUDAN GRASS PASTURE

SUDAN GRASS

BY RUPERT L. STEWART AND LUTHER FOSTER

New Mexico Agricultural Experiment Station

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INTRODUCTION

This bulletin contains results of several years' work with Sudan grass under irrigation, both for hay and for pasture for dairy cows. The figures here tabulated on hay production represent the results of three years' work, and those on pasture are for two years. The work in 1916 and 1917 was conducted on a larger scale than in the previous year.

These tests have been conducted for the purpose of studying the suitability of Sudan grass for both hay and pasture in the irrigated valleys of the State, and to determine, if possible, the best cultural methods for this crop.

DESCRIPTION OF SUDAN GRASS

Sudan grass is probably a native of Egypt, where it is cultivated under the name of "garawi." In 1909 a small amount of this seed was introduced into the United States from Sudan. The grass immediately gave promise of meeting a long felt want, viz., that of having nearly all of the desirable characteristics of Johnson grass, and yet being free from the objectionable feature of rootstocks. This grass crosses quite freely with practically all members of the sorghum family, indicating that it is the wild original form of the cultivated sorghums.

Sudan grass is distinctly an annual, and when seeded broadcast it averages about three to five feet in height, and has fine, slender stems, usually somewhat smaller than a lead pencil. These stems are leafy, perfectly erect, and seldom lodge. If grown in cultivated rows the plants grow much taller and the stems grow larger, being about one-fourth of an inch in diameter. The juice contains a small percentage of sugar, less than is found in the majority of sorghums. The panicle is loose and open, and the seed hulls are awned, but these are mostly all broken off in threshing.

METHOD OF DISTINGUISHING SUDAN GRASS FROM JOHNSON GRASS

Although both the plant and seed of Sudan grass closely resemble Johnson grass, there are certain fundamental differences that enable one to distinguish one from the other. In the first place, Sudan grass has broader and more numerous

leaves. The panicle is larger and more compact than that of the Johnson grass, and the seed of Sudan grass is larger and plumper and is usually of a lighter color. In threshing, the seed of Sudan grass breaks from the seed head or panicle with a small portion of the rachis or branch; the seed of Johnson grass breaks off smoothly, with a well defined scar. The most important difference, however, is that the underground stems or rootstocks which are found on Johnson grass are entirely absent in Sudan. The Sudan grass has a fibrous root system, which prevents it from becoming a troublesome weed as is the case in some instances with Johnson grass. Sudan grass stools quite freely; sometimes as many as 100 stems arise from one crown.

SOIL AND CLIMATIC ADAPTATIONS

Sudan grass has a wide range of adaptation, doing quite well under humid conditions even as far north as latitude 49, and standing drouths in the semi-arid sections as well, if not better, than any other cultivated crop.

Sudan grass is adapted to the same general conditions as the sorghums, but as it ripens earlier it can probably be grown farther north than the majority of the sorghum group. This crop, however, does best in a warm climate; and under favorable conditions, where the growing season is long, several cuttings a year can be obtained.

Sudan grass is not adapted to cold climates, as it is nipped by the first frost. It is not very exacting in its soil requirements, but like all other cultivated crops, does best in a rich soil. The results at the Station indicate that it produces abundantly on heavy adobe soil. It does best on fairly well drained soils, but will withstand a soil that is somewhat waterlogged.

Sudan grass has the valuable characteristic of standing semi-dormant through a period of drouth, and if rain comes before the end of the growing season it will renew its growth.

The Station made an effort to determine just how drouth resistant this crop is by planting some of the seed on the mesa lands adjoining some of the experimental plats and applying different amounts of water. In 1916 two plats were broad-

casted by hand on July 22 and the seed covered with a disc harrow. One plat was given a light irrigation to induce germination, while the other was left unirrigated, it being thought the summer rains might furnish enough moisture to produce a crop. The summer was unusually dry, with only 2.47 inches of rainfall during July, August and September, and as a result the seed on this plat did not even germinate. On the plat that was irrigated the seed germinated and a good stand was the result, but the hot summer sun soon sapped the soil of all available moisture and the majority of the plants died before producing any grass. This experiment was repeated in 1917, with similar results, indicating that Sudan grass cannot be

Fig. 1—Sudan Grass Grown Under Irrigation at the New Mexico Agricultural Experiment Station during 1915

depended upon to produce a crop where the rainfall during the growing season is less than five inches.

SEED BED PREPARATION

Sudan grass requires about the same soil preparation as the sorghums. A fairly firm seed bed is best. The soil should be warm before planting, and as plowing helps to warm the soil, spring plowing is usually preferred, harrowing it down well, as for corn.

DATE OF SEEDING

As stated, the planting should not be done until the soil has become warm. When sown in cold soil the seed germinates slowly and ununiformly and a poor stand is the result. Although the first frost in the fall will turn Sudan grass brown, the young plants apparently can withstand a small amount of frost in the spring without very serious injury.

The results at the Experiment Station indicate that the moderately early plantings give the best yields of hay. In 1916 and 1917 Sudan grass was seeded at about fifteen-day intervals throughout the season, in an effort to determine the best approximate date of seeding. As will be seen from Tables 1 and 2, the April plantings gave the greatest tonnage. It is interesting to note, however, that Sudan grass planted as late as July 16 gave a three-ton yield when planted in 32-inch rows at the rate of four pounds per acre, and yielded 3.8 tons per acre when seeded broadcast at the rate of twenty pounds per acre.

TABLE 1.—YIELDS SECURED UNDER DIFFERENT DATES OF PLANTING, WHEN SOWN BROADCAST AT THE RATE OF TWENTY POUNDS OF SEED PER ACRE.

Date of Seeding	Yield per Acre 1916					1917		
	1st Cut Lbs.	2nd Cut Lbs.	3rd Cut Lbs.	4th Cut Lbs.	Total Lbs.	1st Cut Lbs.	2nd Cut Lbs.	Total Lbs.
Apr. 22 to 26	4015	3486	5465	1227	14193	4820	5800	10620
May 4	4550	4112	4428	969	14059			
May 15	4107	4462	962		9531	5720		5720
June 1	3520	3834	866		8220	6000		6000
June 15	3140	3210	641		6991	6800		6800
July 2						5600		5600
July 16						7600		7600

TABLE 2—YIELDS SECURED UNDER DIFFERENT DATES OF PLANTING, WHEN PLANTED IN 32-INCH ROWS, USING FOUR POUNDS OF SEED PER ACRE, AND CULTIVATED.

	Yield per Acre							
Date of Seeding	1916					1917		
	1st Cut	2nd Cut	3rd Cut	4th Cut	Total	1st Cut	2ndCut	Total
	Lbs.	Lbs.	Lbs	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Apr. 22 to 26	2218	5604	5351	1298	14471	5600	6100	11700
May 4	2362	4950	4780	1020	13112			
May 15	4712	4316	898		9926	4600		4600
June 1	2476	3760	890		7126	5880		5880
June 15	2182	3096	684		5962	6620		6620
July 2						6400		6400
July 16						6000		6000

METHOD OF SEEDING

Sudan grass is usually seeded either broadcast or in rows. When grown under irrigation for hay or pasture it is generally seeded broadcast, but when grown for seed it is planted in cultivated rows and kept free of weeds. In the dry farming districts it is usually seeded in rows and cultivated, in order to conserve moisture by forming a mulch and by keeping down weeds.

Broadcasting and seeding in rows have been compared at the Experiment Station the past three years. In 1915 broadcasting at the rate of 8 pounds per acre was compared with seeding in 32-inch rows at the rate of 2.5 pounds per acre. The land was prepared in the same way and given the same treatment after seeding, and throughout the season. As will be seen from Table 3, the rows gave the better yield. In 1916 and 1917 this test was repeated, and in both cases the broadcasted plats outyielded the row plats. Plats seeded broadcast at the rate of 20 pounds per acre gave slightly lower yields than similar plats seeded in rows at the rate of 4 pounds per acre. Plats seeded broadcast at the rate of 25 pounds per acre yielded slightly less than the row plats in 1916, but in 1917 yielded considerably more hay than did the rows.

In view of the fact that the difference in yield is small, and the quality of hay in the broadcasted plats finer and of better quality, it would seem that, under irrigation, broadcasting is to be preferred to seeding in rows.

TABLE 3—BROADCASTING AND SEEDING IN ROWS COMPARED

	YIELD PER ACRE											
	1915				1916					1917		
	1st Cut	2nd Cut	3rd Cut	Total Yield	1st Cut	2nd Cut	3rd Cut	4th Cut	Total Yield	1st Cut	2nd Cut	Total Yield
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs	Lbs.	Lbs	Lbs.	Lbs.
Broadcast, 8 lbs. per A.	1895	2671	1695	6261	1735	3259	3114	850	8958	2543	3823	6366
Broadcast, 20 lbs per A.					4015	3486	5465	1227	14193	4820	5800	10620
Broadcast, 25 lbs. per A.					3097	2927	3043	684	9751	5360	7560	12920
Rows, 2.5 lbs. per A.	1892	3501	2035	7428	788	2866	3365	891	7910	1680	3050	4730
Rows, 4 lbs. per A.					2218	5604	5351	1298	14471	5600	6100	11700

RATE OF SEEDING

Table 4 gives the result of a rate of seeding test. The object of the experiment was to determine the proper amount of Sudan grass to sow per acre.

TABLE 4—YIELDS SECURED FROM DIFFERENT RATES OF SEEDING, WHEN SOWN BROADCAST

	Yield per Acre							
	1916					1917		
	1st Cut Lbs.	2ndCut Lbs.	3rdCut Lbs.	4th Cut Lbs.	Total Lbs.	1st Cut Lbs.	2ndCut Lbs.	Total Lbs.
Seeded 5 lbs. per A.	1996	2496	3172	360	8024	3160	3000	6160
Seeded 8 lbs. per A.	1735	3259	3114	850	8958	2543	3823	6366
Seeded 10 lbs. per A.	3003	3930	3253	644	10830	3440	3400	6840
[illegible] per A.	3367	3430	3684	681	11162	3640	3960	7600
Seeded 20 lbs. per A.	4015	3486	5465	1227	14193	4820	5800	10620
Seeded 25 lbs. per A.	3097	2927	3043	684	9751	5360	7560	12920
Seeded 30 lbs. per A.	2830	2116	3572	640	9158	4600	7000	11600
Seeded 35 lbs. per A.	1814	3364	2582	526	8286	5240	6600	11800

As will be seen from the table, 20 pounds per acre gave the highest yield in 1916, and plats seeded at the rate of 25 pounds per acre gave the greatest tonnage in 1917. It would seem that 20 to 25 pounds per acre is the best amount of Sudan grass seed to plant to the acre, when sown broadcast. In 1916 the yield increased in direct proportion to the rate of seeding until 20 pounds per acre was reached. Then the yield decreased as the rate increased. In 1917 the same holds true, except that the increase continued until 25 pounds of seed per acre was sown.

Only two tests were made to compare effect of different rates of seeding when planted in rows.

TABLE 5—YIELDS SECURED FROM DIFFERENT RATES OF SEEDING, WHEN PLANTED IN 32-INCH ROWS

	Yield per Acre							
	1916					1917		
	1st Cut Lbs.	2nd Cut Lbs.	3rd Cut Lbs.	4th Cut Lbs.	Total Lbs.	1st Cut Lbs.	2nd Cut Lbs.	Total Lbs.
Seeded 2.5 lbs. per A.	788	2866	3365	891	7910	1680	3050	4730
Seeded 4 lbs per A.	2218	5604	5351	1298	14471	5600	6100	11700

In 1916 and 1917 plats planted at the rate of 2.5 pounds per acre were compared with plats planted at the rate of 4 pounds per acre, and in both years the heavier seeding gave the higher yields. This would probably not be true in regions

of limited moisture supply. Two to three pounds per acre is usually sufficient in the dry farming districts.

HARVESTING FOR HAY

Sudan grass when cut for hay is harvested in a manner similar to alfalfa; that is, it is cut with a mower and raked and bunched or put in cocks, and allowed to cure before hauling to the barn or stack. The crop is best cut when in full bloom; when the leaves are retained well and a bright, leafy, sweet hay is secured.

HARVESTING FOR SEED

When raised for seed, Sudan grass is usually harvested with an ordinary grain binder and shocked, as with the small grains. It should be cut when the first heads are fully ripe, thus avoiding loss by shattering. The seed can be threshed with the same machine as is used for wheat or barley.

PASTURE

For the first pasture experiment a tract of land containing 8.6 acres was seeded to Sudan grass April 19, 1916, at the rate of 20 pounds of seed per acre, an ordinary Hoosier disk drill being used for the purpose. This piece of land was divided into two equal fields, which were arranged so that they could be conveniently irrigated and pastured alternately. They were designated Field A and Field B.

By June 19, just sixty days after seeding, the grass was in excellent condition for pasturing, averaging 22 inches in height, when twelve dairy cows, averaging 1058 pounds in weight, were turned on to one of the fields. After a few days it was found that twelve cows were not sufficient to catch up with the growth the pasture was making, and eight additional larger cows, averaging 1186 pounds in weight, were added for twelve days, when the pasture was reduced to the right condition and the extra cows removed. The two fields were irrigated and pastured alternately during the season, the changes being made at intervals of about two weeks. Heavy rains came about the middle of October, making these fields muddy and the weather too cold for the grass to grow much. The cows were taken off the pasture October 13 and the experi-

ment closed October 20; but still later, in November, twenty-five head of dry cows, beef cattle and young stock were run on the two fields for a period of eight days, and the pasture furnished an abundant supply of feed during that time. The cows were kept on these pastures as follows:

Field A.	No. Days.	Field B.	No. Days.
June 19 to 24	5	June 24 to July 7	13
July 7 to 22	15	July 22 to Aug. 3	12
Aug. 3 to 15	12	Aug. 15 to Aug. 27	12
Aug. 27 to Sept. 12	16	Sept. 12 to Sept. 22	10
Sept. 22 to Oct. 1	9	Oct. 1 to Oct. 13	12

Each pasture was irrigated as soon as the cows were taken off, and during the twelve to fifteen days between the changes the grass grew from 10 to 12 inches in height. The last week of the experiment, after the rains began and the nights became cool, the pasture temporarily stopped growing and the cows were fed an average of 175 pounds of alfalfa hay per head. Six of the twelve cows that were kept on the pasture constantly, day and night, from June 19 to October 13, had a small grain ration, averaging about four pounds per head. The twelve cows were divided into two lots, and the grain ration was alternated from one lot to the other every thirty days, so that the cows received exactly the same treatment and were practically in the same relative condition at the close of the experiment. The result of this part of the experiment shows that it does not pay to feed a grain ration to dairy cows running on good Sudan grass pasture. During the four months that they were on pasture they made a total gain of 1228 pounds, an average of 102 pounds per head, and gave 28,638 pounds of milk, which produced 1,145 pounds of butterfat. The eight dairy and beef cows that were temporarily on the pasture gained 20 pounds per head or a total of 160 pounds in twelve days. The pasture carried an average of 1.74 cow per acre for 116 days.

Fig. 2—Dairy Cows on an Irrigated Sudan Grass Pasture at the New Mexico Agricultural Experiment Station

There was no indication of prussic acid poisoning from pasturing this grass in November, after the frost came, though the same care should be taken when pasturing Sudan grass as when pasturing any of the other sorghums.

A small field containing 3.46 acres was seeded to Sudan grass with a drill May 14, 1917, at the rate of 20 pounds of seed per acre, for the second test of Sudan grass for pasture. The grass made quick growth, and averaged 10 inches in height by June 21, when the dairy herd was turned on to it. Owing to the fact that a portion of this pasture was damaged or killed by flooding, the experiment was not wholly satisfactory; but making proper deduction for injury caused by the water, the results showed that an acre of Sudan pasture will carry two average cows of 1000 pounds weight for a period of four months, or for the rest of the season after the grass is large enough to turn on to.

Judging from these two trials, Sudan grass should prove to be one of the best annuals for pasture during the season of the year covered by the experiments. It is of good quality, makes quick growth after being pastured off and responds promptly to irrigation. A number of years' experience with Johnson grass, which is very similar to Sudan, proved it to be

excellent for pasture, but because of the difficulty of eradicating it when it once gets a foothold its use is not recommended, except in isolated fields intended for permanent pasture. In composition and digestibility for both pasture and hay, Sudan grass is about the same as Johnson grass or timothy. The Sudan hay has more protein than Johnson grass hay, but is a little lower in fats, nitrogen-free extract and crude fiber than the latter.

For pasture, the place of Sudan grass and other annuals is to supplement the permanent pastures during the summer; but as compared with permanent pasture they are at a disadvantage, because the ground is necessarily soft and subject to injury from trampling, even under favorable conditions, as they do not form a turf. Some of the plants, too, are pulled up by the roots at the first grazing. On account of this, Sudan grass should not be pastured the first time until 15 to 18 inches high, particularly on sandy or loamy soils. In some localities it is claimed that the experience of farmers shows that the best results are obtained by cutting the first crop for hay or seed, and then pasturing the field the rest of the season, turning the stock on as soon as the new growth is well started. This method would largely obviate the disadvantages mentioned above.

SUMMARY

1. Sudan grass is very similar to the other sorghums in habit of growth.
2. It is quite drouth resistant and can be grown at high elevations.
3. It has produced from 3 to 7 1-4 tons per acre per season under irrigation at the New Mexico Agricultural Experiment Station.
4. Early plantings have given best results at the Station; but it will not stand much frost.
5. Twenty to twenty-five pounds of seed per acre seem to be the best amount to sow when seeded broadcast.
6. Seeding in rows gave better yields than sowing broadcast, but the hay was coarser.
7. The experiments indicate that Sudan grass makes a good supplementary pasture for dairy cows.

9

BULLETIN NO. 112
May, 1918

NEW MEXICO COLLEGE OF AGRICULTURE AND MECHANIC ARTS

Agricultural Experiment Station
State College, N. M.

THE JERSEY SIRLOIN

BABY BEEF

BY LUTHER FOSTER AND E. J. MAYNARD

NEW MEXICO AGRICULTURAL EXPERIMENT STATION

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BABY BEEF

OBJECT OF EXPERIMENT

This experiment was planned in anticipation of this State's becoming largely interested in the dairy business. In it a comparison was made of the beef and dairy types of cattle as beef producers, the object being to determine if it will pay the dairymen best to keep their calves, feed them until they are fourteen to twenty months old and sell them for baby beef and thus increase the meat supply, or if it is more profitable to sell them as veal. For this initial experiment only four calves were used, two of strong beef types and two of high grade dairy types.

The beef types were permitted to run with their mothers, one until 260, and the other until 330 days old, and from that time on they were given a full feed of grain and hay or grain and pasture, in order to put them in good condition for the block as early as possible.

The dairy type calves were raised in the manner in which dairy calves are usually reared; that is, they were taken away from their mothers at a few days old and were gradually put on skimmilk and a grain ration and fed as liberally as possible on the rations allowed in this method of rearing. It was presumed that with the best feeding that could be given under this plan of bringing them up they would not be ready for the butcher until somewhat later than the beef calves; perhaps at eighteen or twenty months old. The particular calves of the beef type used in this experiment were two cross-bred steers, an Angus-Hereford and a Shorthorn-Hereford; and the two calves of the dairy type were a high grade Holstein and a high grade Jersey. It is hoped that the results of this test will give a very good idea of what it will cost to properly rear and fatten for market calves of each class, and will show the comparative percentage of dressed meat and its quality.

EFFECT ON MEAT SUPPLY

During the present shortage of meats, it is obvious that the plan of making baby beef of the dairy male calves instead of veal would materially increase the meat supply. The Mesilla Valley alone now has 600 cows on its farms. If the calves that ordinarily go to the market as veal —about half—were kept until 16 to 20 months old, they would increase the meat supply of the Valley by at least 150,000 pounds of dressed beef.

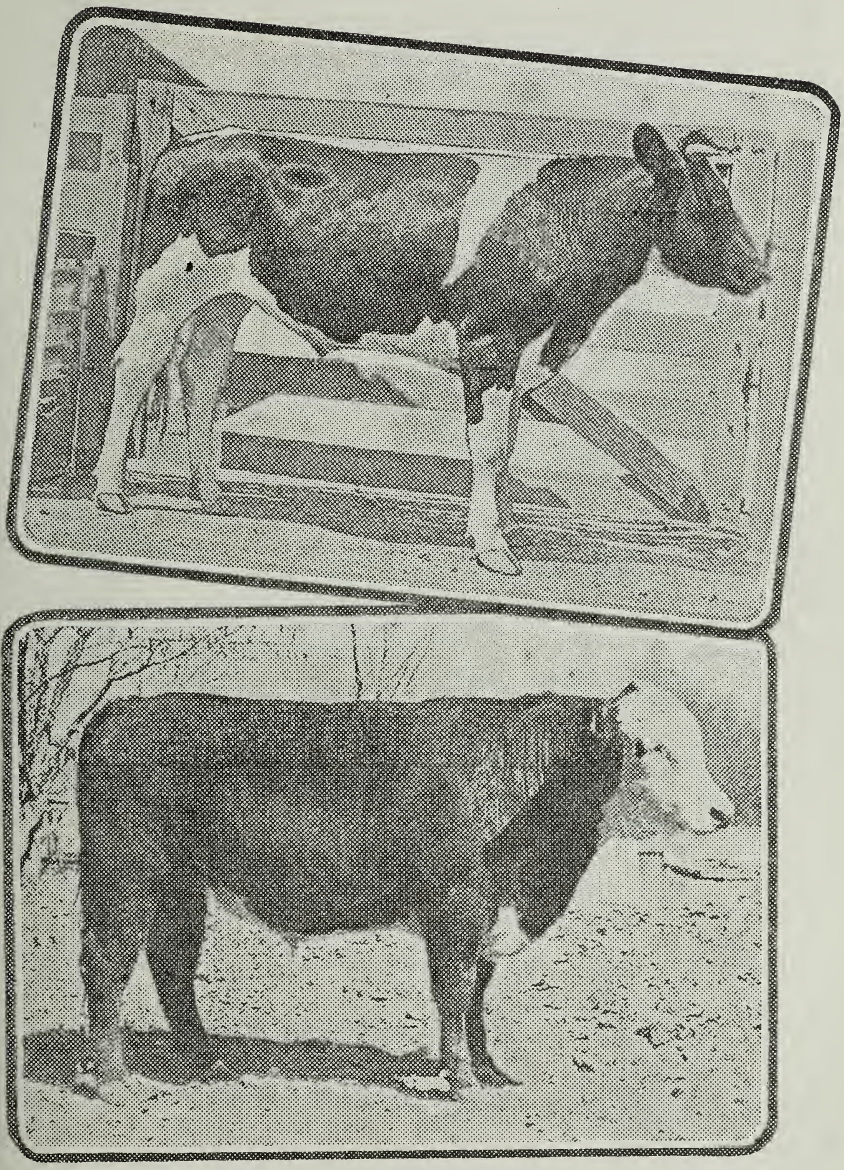


Fig. 1. Grade Holstein-Friesian.
Angus-Hereford Cross.

The dairy districts of the State have a total of about 6,600 milk cows. Holding the veal calves as above would mean an increase of the dressed beef supply in the State of 1,650,000 pounds.

Dairy farming has only recently been introduced into the Southwest, and under the present system of management and marketing it should rapidly develop and soon become one of the principal sources of income on a large per cent of the farms in the irrigated valleys. With this outlook, the raising of the dairy calf becomes still more important as an element in increasing the meat supply. For all such beef as might at present be produced in the State there should be demand in the local markets at the prices paid for Fort Worth and Kansas City beef.

WHAT IS BABY BEEF?

What is known as baby beef is produced by a system of fattening calves as they grow and finishing them for beef at from 14 to 20 months of age. This intensive method of beef production has been practiced in general only with calves of the beef breeds, but there is no reason why calves of the dairy type may not be brought to a sufficient degree of maturity for beef at an earlier age than usual by a system of better feeding. Even if a somewhat longer period is required than with beef breeds, it might still prove a desirable and profitable practice. It seems that the dairy breeds, particularly the Holsteins, make just as large gains as any of the beef breeds, though the degree of finish may not be equal to them at as early an age. In general, when fed in the same manner, calves of the dairy breeds make just as rapid gains as those of the beef breeds. Even when as mature and well finished as the beef type, their general external appearance may not so strongly indicate it as does the more blocky, broad loined beef type.

The calf intended for baby beef should be kept growing continuously from the time it is dropped until it goes to the butcher and never be permitted to lose its calf bloom or fat. It should be taught to eat concentrates as soon as old enough. This may be made of a mixture of whatever grains are on hand, or those that are the cheapest, such as corn, milo or barley, with oats and wheat bran. A grain ration with choice alfalfa hay or good pasture will keep the calf growing and fattening. With present high prices of land, there is a tendency to substitute silage for pasture, and calves do well on it as a part ration, on account of its succulence.

ECONOMY OF BABY BEEF

A recent farmers' bulletin on the production of baby beef tells why its production is more advantageous, and gives the causes that have increased the tendency toward producing this class of beef rather than that of the former class. The author claims that consumers of today are demanding small cuts of good quality meat, and since the cost of producing this kind of beef is less, the higher values of land, feeds and labor have increased the tendency in that direction; that is, the consumer demands this kind of beef, and the feeder is glad to furnish it because he can do so at a less cost of production.

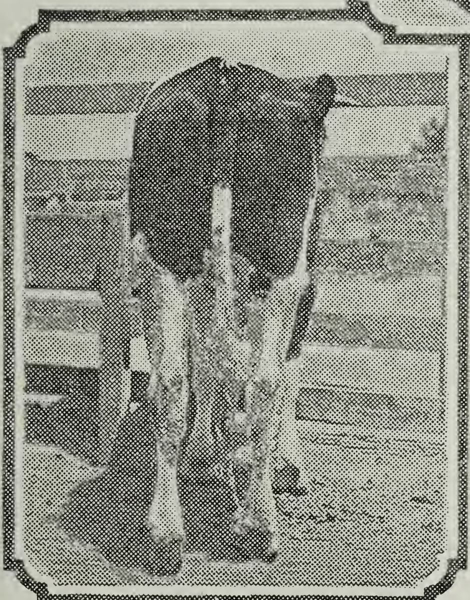


Fig. 2. Angus-Hereford Cross.
Grade Holstein-Friesian.

Numerous experiments have shown that young cattle make better gains than older ones on the same quantity of feed; that is, the yearlings will make 25% to 40% more gain than more mature animals on exactly the same feed. Putting it in another way, the quantity of feed necessary to make 100 pounds of gain increases constantly with the age of the animal. By getting a calf

ready for market at 15 months insead of 30, the money is turned in half the time, and the risk of losing the animal by disease or accident is only half as great.

An investigation was recently completed at this Station to determine at what age range steers should be fed for market in order to secure the best results. In this experiment calves, yearlings, two-year-olds and three-year-olds were fed on like rations and under identical conditions. The comparative utilization of the feed was measured by the gains in live weight, the feed required for a pound of gain, the degree of finish of the steers, the slaughter and block tests, the analysis of the meats, and a comparison of the digestibility of the feed by the steers of the different ages. While it was presumed that the appetite and the digestive and assimilative powers were more active in the calf than in the older steer, the results did not prove this to be true, for the steers of the different ages digested their rations equally well, and their appetites seemed equally good. But the calves excelled in the utilization of the feed, as shown by their very much larger gains and the smaller quantity of feed required for a pound of gain. When calculated on a common basis of a thousand pounds live weight, the average daily gains of the different ages were as follows: First trial—calves, 3.18 pounds; yearlings, 2.22 pounds; two-year-olds, 2.15 pounds; and three-year-olds, .96 pound. Second trial—calves, 2.70 pounds; yearlings, 2.21 pounds; two-year-olds, 2.25 pounds; and three-year-olds, 1.52 pounds. The still more important and decisive point was the quantity of feed consumed for each pound of gain by the steers of the different ages. This was as follows: First trial—calves, 7.77 pounds; yearlings, 11.11 pounds; two-year-olds, 11.46 pounds; and three-year-olds, 20.34 pounds. Second trial—calves, 6.96 pounds; yearlings, 9.57 pounds; two-year-olds, 9.63 pounds; and three-year-olds, 12.60 pounds. These figures are quite conclusive, and indicate very decidedly that the greatest profit comes in feeding cattle for beef by taking the calf at weaning time and feeding him off for market as rapidly as possible without losing the calf bloom.

In comparing the percentages of dressed beef there were no significant differences that could be ascribed to the differences in ages among the groups of steers, and no distinctive differences were apparent in reference to the wholesale cuts of meat from the steers of various ages. Neither were there any decided differences as shown by chemical analyses. All the meat was of good quality, and no distinctive flavor on account of age was noticeable.

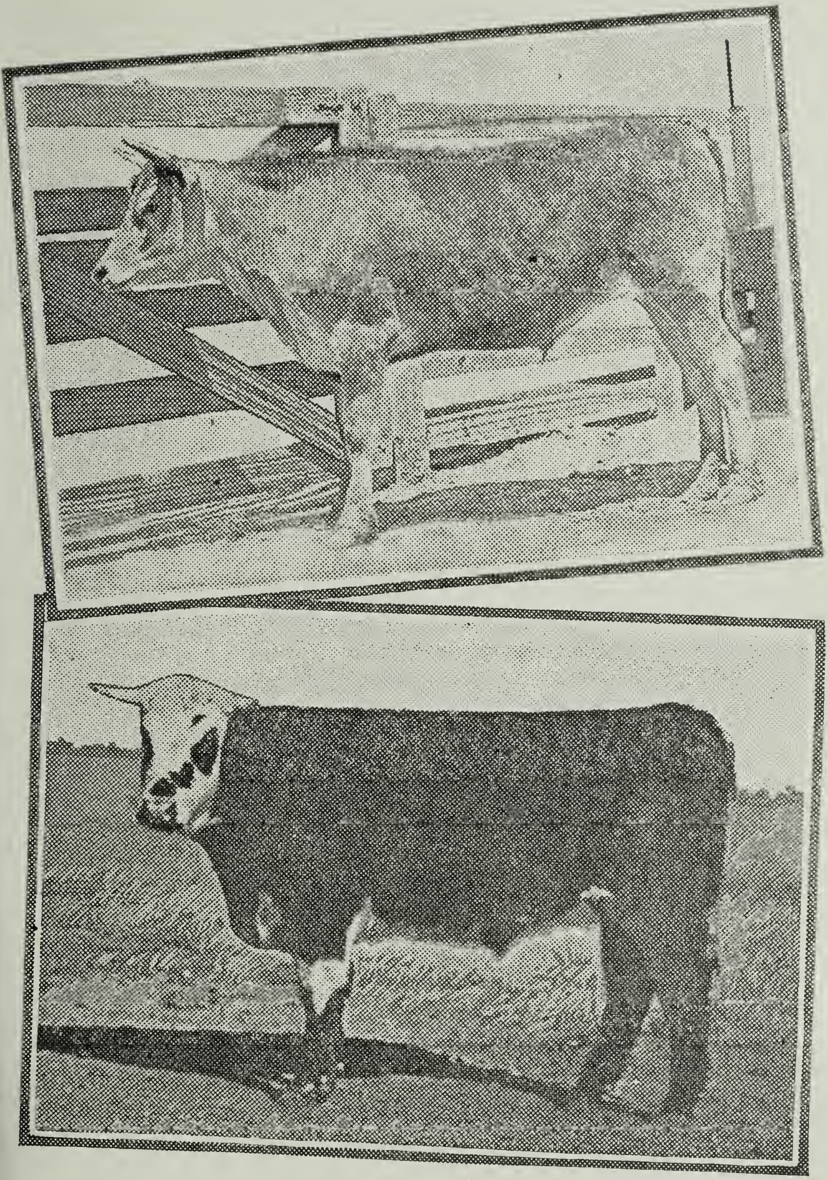


Fig. 3. Grade Jersey.
Shorthorn-Hereford Cross.

Numerous experiments of other stations show the same thing; that is, that fewer pounds of feed are required to produce a pound of gain while the animal is young than when it grows older; that the cost of gains for the first six months is less than for the second six months, less during the second six months than during any succeeding period; and so on to maturity. And in general the younger animal gives more profitable returns for the food eaten than the more mature one.

While there is always a good demand for this class of beef, it is not necessary that it be marketed at any definite, fixed time. It may vary a month or two, if necessary, awaiting a better price, and the gain during the time will be sufficient to pay for the extra feed, at least, while the finish will be improved.

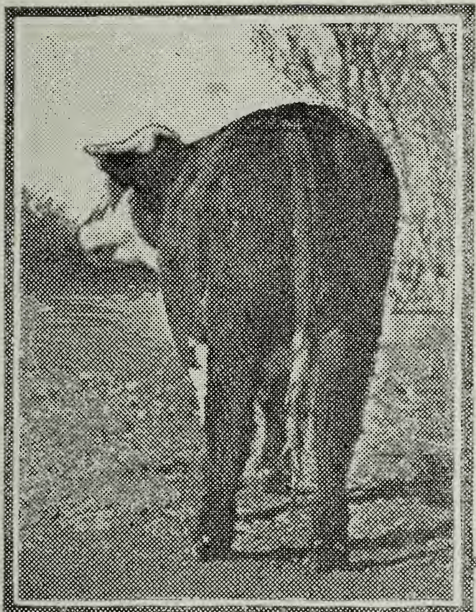
The facts mentioned above apply particularly to cattle kept on the farm or range for the production of beef, but they apply with equal force to the dairy breeds of the irrigated valleys of New Mexico.

COST OF BEEF TYPE CALF

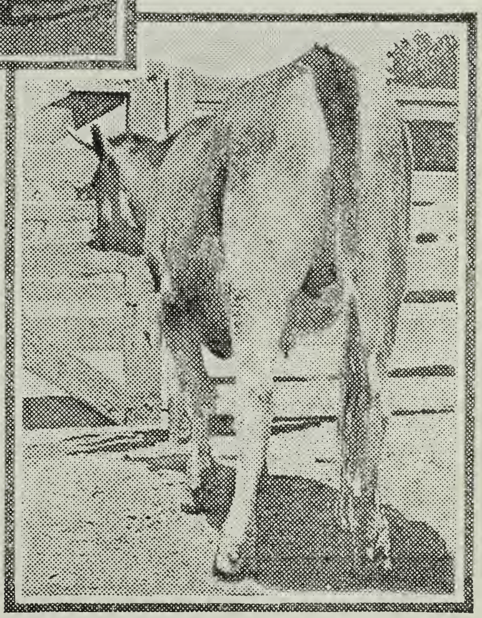
In estimating the cost of a beef type calf a number of items must be considered. In the experiment the cost of keeping a cow of the beef type is approximated at $36.00 for the year, and that amount was charged up as the cost of the calf at weaning time. This will, of course, vary under different conditions. The items usually taken into account are the keep of the cow, interest on the value of the cow, the risk, the cost of bull service, and the per cent of cows that raise calves. With plenty of cheap pasture and unmarketable roughage, this initial cost might be reduced considerably, but under present farm conditions in this State it is doubtful if cows can be profitably kept on an irrigated farm for the sole purpose of producing beef calves, though the results of this experiment are favorable to it.

CALF ESSENTIAL TO DAIRY

The dairy calf is a different proposition. It is an essential adjunct of the dairy, and must be produced if the dairy is kept going. The only question left for the dairy farmer is to decide how best to dispose of it. The figures here presented will give a fair idea of what it will cost to convert it into baby beef. Making veal of it is a separate question. The proper veal age is 6 to 8 weeks, and a calf rightly handled and fed makes the best and most desirable veal at that age. If younger the quality is inferior, and if much older the pure veal stage has passed, but over 8 weeks is much more desirable than under six. Many prefer veal from 8 to 12 weeks old rather than younger, but unless a calf remains with its



that the roughage and grain produced on the farm have been disposed of through the calf at a good price and the manure has been returned to the land and that at the same time assistance has been given in increasing the much needed meat supply of the country.



mother, or is given whole milk, it is very difficult to make a fine quality of veal at any age. The medium sized veal is usually in greatest demand and brings the highest price, one that dresses from 80 to 120 pounds. The dairyman may choose between these two methods of disposing of the calves he does not intend to keep to replenish his herd, or sell them at a nominal price to some one who is making a business of raising such calves. Even though the profits may not seem large, it should be kept in mind

Fig. 4. Short-horn-Hereford Cross.
Grade Jersey.

COST SHEET

The following statement shows the feeds eaten and the approximate cost of the different calves when 583 days old:

Steer No. 1. Shorthorn-Hereford.

1863 pounds of grain	$27.95	
2823 pounds of alfalfa hay	14.12	
165 days on pasture	5.50	
Cow charge	36.00	
		$83.57

Steer No. 2. Angus-Hereford.

2696 pounds of grain	$40.45	
3166 pounds of alfalfa hay	15.83	
165 days on pasture	5.50	
Cow charge	36.00	
		$97.78

Steer No. 3. Grade Holstein.

100 pounds whole milk	$ 2.50	
3080 pounds skimmilk	4.62	
3332 pounds grain	49.98	
4387 pounds alfalfa hay	21.95	
72 days on pasture	2.40	
		$81.45

Steer No. 4. Grade Jersey.

100 pounds whole milk	$ 2.50	
3080 pounds skimmilk	4.62	
3332 pounds grain	49.98	
4387 pounds alfalfa hay	21.95	
72 days on pasture	2.40	
		$81.45

In estimating the cost of the feeds, the prices used were those prevailing at the time of the experiment, which were as follows: Grain, per cwt., $1.50; alfalfa hay, per ton, $10.00; skim milk, per cwt., 15c; pasture, per mo., $1.00.

FINAL STATEMENT

	Steer No. 1	Steer No. 2	Steer No. 3	Steer No. 4
Age of steer when slaughtered, days	583	583	583	583
Approximate birth weight, lbs.,	90	90	90	60
Weight at close of experiment, lbs	1140	1120	984	860
Gain, lbs.,	1050	1030	894	800
Average daily gain, lbs.,	1.8	1.76	1.53	1.37
Total pounds grain consumed	1863	2696	3332	3332
Total pounds hay consumed	2823	3166	4387	4387
Grain required per pound of gain, lbs.,	1.77	2.61	3.72	3.11
Hay required per pound of gain, lbs.,	1.68	3.07	4.45	5.84
Total cost of production	$83.57	$97.78	$81.45	$81.45
Cost per day	.143	.167	.139	.139
Cost per pound live weight	.073	.087	.082	.101
Value at 13c live weight	$148.20	$145.60	$127.92	$111.80
Profit per steer over total cost	$64.63	$47.82	$46.47	$30.35
Dressing out percentage	59.57%	60.54%	63.09%	60.31%

REMARKS

The calves were dropped at different dates during the season of 1915, and while they were kept the same number of days, 583, the feeding period did not cover exactly the same months. They were dropped as follows: No. 1, May 24; No. 2, Aug. 2; No. 3, Oct. 24; and No. 4, Oct. 25. The dates at which they were slaughtered are as follows: No. 1, Dec. 28, 1916; No. 2, March 8, 1917; and Nos. 3 and 4, May 31 and June 1, 1917, respectively.

The dairy calves were in excellent condition March 8, at the time No. 2 was slaughtered, and would have given as much profit had they been disposed of at that date as they did at the end of the experiment. The feeding for the next 84 days gave them a higher degree of finish, but the gains were scarcely sufficient at the price mentioned to pay for the food eaten. In fact, all the steers would have made an excellent quality of beef at 14 to 16 months of age, and would have returned almost as much profit as they did at the close of the experiment. They would not, of course, have had quite as good a finish as the final feeding gave them, and their market price in consequence might have been slightly less.

Referring to the table, it will be seen that there was a variation of only 20 pounds in the gains of the two beef steers, and 94 pounds in the dairy steers, but this latter was to be expected on account of the difference in size of the two dairy breeds represented. The lighter steer of the beef type and the heavier one of the dairy type differed in gains by only 136 pounds, and the average of the two types differed by 193 pounds. These differences of gain are no greater than may be found among steers of the same age of either type, or of different beef types. The difference is small, considering the entirely different methods of raising the calves, and it shows very favorable for the dairy type as baby beef producers.

The total cost of production per individual was more for the beef type than for the dairy, but the actual cost per pound of gain in live weight was less for the beef type.

The rather wide difference in the cost of the beef steers is principally due to the fact that No. 1, the Shorthorn-Hereford, ran with his mother 70 days longer than did No. 2, the Angus-Hereford, making a difference in the quantity of grain and hay consumed.

The beef type steers made slightly greater average daily gains than did the dairy, but there was a difference of only .23 pound between the lighter beef steer and the heavier dairy, and, taking the average of the

two sets, there was only .33 of a pound gain per day in favor of the beef type. It should be kept in mind that the beef type steers were both of the large beef breeds, and that the dairy type was represented by one from the largest and one from the smallest of the dairy breeds, making the average representative of the dairy breeds only medium in size. All points considered, the indications are that the dairy type calves may be satisfactorily fed off as baby beef, producing a quality that compares favorably with the beef type, and giving satisfactory profits.

The dairy steers excelled in the dressing percentage by 1.65%. The Grade Holstein dressed highest of all, 63.09%, and the Shorthorn-Hereford the lowest, 59.57%. All dressed out well, indicating a fine degree of finish. The grade Holstein gave a profit almost equal to that of the Angus-Hereford, the difference being only $1.35, but the average profit on the beef type exceeded that on the dairy by $17.81.

In form and general appearance the beef type excelled, but in handling, thickness of cuts, marbling of fat and lean, the general appearance of the dressed carcass, both outside and in, the flavor of the meat, its tenderness and juiciness, there was little if any difference.

The results of this experiment indicate that grade dairy type calves, raised under average dairy farm conditions and properly fed until 14 to 20 months of age, produce excellent quality baby beef at a reasonable cost of production, which may be disposed of at a fair profit, even on the local markets, and if the plan of rearing dairy calves for beef is generally followed instead of disposing of them as veal, the meat supply of the State will be substantially increased.

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New Mexico College of Agriculture and Mechanic Arts

Agricultural Experiment Station
State College, N. M.

In cooperation with United States Department of Agriculture, Weather Bureau.

CLIMATE IN RELATION TO CROP ADAPTATION IN NEW MEXICO

BY
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AND
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New Mexico Agricultural Experiment Station

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CLIMATE IN RELATION TO CROP ADAPTATION IN NEW MEXICO

INTRODUCTION

New Mexico is almost square in outline, being 350 miles from north to south, and about the same from east to west. On account of its varied topography the elevations range from about 3,000 feet in the southeastern corner to more than 14,000 feet at the top of the highest mountains. On the whole, New Mexico consists of high plateaus or mesas, with numerous mountain ranges, canyons and valleys; some of the valleys are large enough to make possible the carrying on of extensive agricultural operations under irrigation.

Because of the great range in altitude, climatic conditions are extremely varied, which must be taken into consideration in all agricultural operations. When it is considered that practically all of the farming not carried on under irrigation is being done by dry farming methods, which is now being carried on in altitudes varying from 3,000 feet to about 8,000 feet, under a normal precipitation varying from about 10 to 20 inches, and with a long growing season in the lower altitudes to a very short one in the high altitudes,—it can readily be seen that the limiting factors in crop production vary widely. Therefore it is evident how important it is for farmers to have some knowledge in regard to plant adaptation in New Mexico, and to study thoroughly the conditions in order that serious mistakes may be avoided.

Crops adapted to the unirrigated districts in either the lower or higher altitudes are comparatively small in number. The amount of moisture and length of the growing season are two important limiting factors for many crops in New Mexico. The 5,000-foot elevation is probably about the limit in altitude for many of the sorghums, which are among the best crops for the dry farmers below this altitude; however, up to this altitude Sudan grass, beans, Indian corn, broom corn

and wheat are also dependable crops. In the higher dry land districts short season corn, wheat, barley, oats, field peas, beans, and, in some districts, Irish potatoes, are among the leading crops to grow.

In the irrigated valleys, where the moisture factor is largely under the control of the farmer, a much larger variety of crops can be successfully raised, under *good farm management.* In addition to a large variety of vegetables and fruits, practically all of the crops that can be raised by dry farming can be grown in these irrigated districts of lower altitude. In the high altitude, mountainous, irrigated districts, aside from the dry farming crops that are grown under these conditions, alfalfa, many of the cool season vegetables, and a number of fruits, principally apples, cherries and plums, are usually grown successfully, except that the late spring frosts occasionally partly or wholly destroy the fruit crop.

In this bulletin only a brief discussion is given in regard to the agricultural possibilities in each county. On account of its size it would not be wise to go into detail as regards the many varieties of the different agricultural crops that are grown in each county, or to give descriptions of the different types of soils that are to be found in each locality, and the crops suited to them.

The precipitation and temperature data given will aid materially in deciding whether or not there is enough rainfall and whether the growing season is long enough to raise the different crops in those particlar localities, if something is known about the climatic requirements of the crops. Because of the varied topographical and climatic conditions in New Mexico a large portion cannot be used for the growing of crops, but it can be used for the raising of livestock, which is a most prosperous industry in all localities where there is enough range for grazing purposes.

The need of definite information on the precipitation and temperature in connection with plant growth in New Mexico has long been felt. These data, which are of immense value, not only to the New Mexico stockmen and farmers, but to people from other states who contemplate coming to New Mexico to engage in agricultural pursuits, are now available.

Relief Map of New Mexico,
Giving a General View of the More Prominent Topographical Features.

BERNALILLO COUNTY

STATION—ALBUQUERQUE. APPROX. LATITUDE—35° 5′. LONG.—106° 38′. ELEVATION—5,200 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Precipitation	1850	*0.32	0.05	0.01	0.02	0.21	0.18	1.26	0.45	0.51	0.28	1.02	0.61	*4.92	2.63	..
	1851	0.07	0.56	0.42	0.04	0.03	0	0.30	....	....	....	....	.....	.....	.....	..
	1852	.....	....	....	0.70	0.07	8.15	0.07	4.06	0.19	0.35	0.16	0.02	.....	13.24	..
	1853	0	0	0.01	0	0.04	0	2.57	3.80	0.07	0	0.31	0.30	7.10	6.48	..
	1854	0.13	0	0.43	0.39	1.19	0.28	2.59	1.19	2.67	1.37	1.35	0.92	12.51	8.31	..
	1855	0.20	0.40	1.02	0.74	0.89	....	....	....	....	....	0.77	.....	.....	.....	..
	1856	0.20	0.20	0.19	0.10	0.23	0.25	0.17	1.23	1.12	0.10	0.33	0.03	4.15	3.10	..
	1857	1.45	0.25	0	0.15	0	0.10	0.35	0.77	0.78	1.25	0.10	0	5.20	2.15	..
	1858	0	0.50	0.80	1.60	0	3.50	3.60	4.90	0	0	0	1.40	16.30	13.60	..
	1859	0	0	0.15	0.15	0	0	0.25	2.30	3.10	0	0	0	5.95	5.80	..
	1860	0.70	0.30	0	0	0	0.70	0.20	1.00	0.35	0	0.52	0.01	3.78	2.25	..
	1861	.....	0	T.	....	.....	....	0.38	0.34	0.67	....	0	.....	.....	.....	..
	1863	.....	....	....	....	T.	....	....	....	0	1.20	0.05	0.19	.....	.....	..
	1864	0.37	0	T.	T.	0.10	1.84	0.90	0.25	0.30	0.67	0.52	0.59	5.54	3.39	..
	1865	0.20	0.39	0.10	0.20	*0.19	1.45	1.00	1.30	0	5.40	0	0.12	*10.35	4.14	..
	1866	0.20	0.10	....	....	....	....	....	....	0.90	0.32	0.17	.....	.....		..
	1867	0.45	0.16	0.02	0.02	.....	....	0.41	....	....	....	....	.....	.....		..
	1878	.....	....	....	....	.....	....	....	....	....	0	1.83	0.07	.....		..
	1879	0.49	0.26	0.02	0.02	0.03	T.	....	....	....	....	....	.....	.....		..
	1881	.....	....	0.04	....	.....	....	....	....	....	....	....	.....	.....		..
	1888	.....	....	....	....	0.39	T.	....	....	....	....	....	.....	.....		..
	1889	.....	....	....	0.70	T.	0.53	0.77	0.21	0.18	0.76	0	.....	.....	2.39	..
	1890	.....	....	....	....	0.04	0	2.07	0.61	0.97	0.15	....	.....	.....		..
	1891	.....	....	....	....	.....	....	....	....	....	....	....	0.02	.....		..
	1892	0.81	0.84	0.81	0.20	0.12	0.08	1.45	0.21	T.	2.21	0	0.11	6.84	2.06	..
	1893	0.31	0.07	0.22	T.	0.45	T.	1.27	1.88	2.95	0.09	0.17	0.01	7.42	6.55	..
	1894	0.01	0.31	0.18	0.60	0.80	0.03	0.42	2.25	0.32	0.49	T.	0.31	5.72	4.42	..
	1895	1.29	0.60	0.07	0.08	1.73	0.34	2.78	0.80	0.18	0.74	0.85	0.32	9.78	5.91	..
	1896	0.06	0.07	0.01	T.	0.07	0.32	1.98	0.81	0.72	2.55	0.05	0.38	7.02	3.90	..
	1897	0.57	0.13	0.72	0.63	2.07	0.99	0.31	1.31	1.22	1.44	T.	0.35	9.74	6.53	..
	1898	0.58	0.54	0.34	0.33	0.12	1.00	1.25	0.60	0.28	0.15	0.50	0.70	6.39	3.58	..
	1899	0.35	0.35	0.40	0.34	0	0.44	3.23	0.63	1.20	T.	0.20	*0.02	*7.16	5.84	..
	1900	0.70	0.40	0.13	0.33	0.85	0.06	0.13	0.13	2.09	0.25	0.83	T.	5.90	3.59	..
	1901	0.65	0.69	0.15	0.30	0.55	0.30	1.46	1.85	1.21	2.00	1.03	T.	10.19	5.67	..
	1902	0.32	T.	T.	0	0.23	T.	1.20	0.70	0.55	T.	1.10	0.84	4.94	2.68	..
	1903	0.08	0.41	0.38	0.05	0.18	2.48	0.32	0	1.93	0	0	0	5.83	4.96	..

	Year	Jan.	Feb.	Mar.	Apr.	May.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
	1904	0.20	0.10	T.	T.	1.19	0.32	0.94	1.88	1.42	0.17	0	0.60	6.82	5.75	..
	1905	1.00	T.	T.	4.20	0	1.37	0.22	0.72	0.59	0	4.70	2.93	15.73	7.10	..
	1906	0.20	T.	0.30	1.05	0.05	0.06	1.93	0.85	1.80	0.52	0.40	1.20	8.36	5.74	..
	1907	0.37	0	0	2.50	1.42	0.18	0.93	1.66	0.20	1.50	0.42	0.01	9.19	6.89	..
	1908	0.42	0.34	0	2.09	0.34	0.28	1.52	1.75	0.37	0.22	0.04	0.24	7.61	6.35	..
	1909	0.37	0.17	0.11	0.12	0.16	0.12	0.85	1.56	0.52	0	0.25	0.19	4.42	3.33	..
	1910	0.14	0.31	0.30	0.55	0.63	0.79	1.88	1.51	0.06	0.29	0.73	0.22	7.41	5.42	..
	1911	0.33	1.73	0.42	0.28	0.28	1.26	2.14	0.62	1.04	3.30	0.34	0.20	11.94	5.62	..
	1912	0.02	0.19	0.74	0.13	0.30	0.64	2.39	0.63	0.29	0.29	0	0.47	6.09	4.38	..
	1913	0.78	0.41	0.15	0.44	0.24	0.99	0.46	0.59	0.55	0.31	0.69	1.06	6.67	3.27	..
	1914	0.02	0.40	0.40	0.84	1.02	0.14	2.01	2.00	0.20	1.93	0	2.43	11.39	6.21	..
	1915	0.68	0.56	0.51	2.05	.....	....	2.92	0.83	1.18	....	....	.....	.....	.....	..
	1916	2.52	....	....	....	.....	....	....	1.95	0.34	2.77	0	T.	.....	.....	..
	1917	0.35	0.73	T.	0.12	0.50	0.18	0.25	0.56	0.60	T.	T.	0	3.29	2.21	..
Mean		0.44	0.31	0.23	0.54	0.40	0.74	1.25	1.22	0.80	0.76	0.46	0.44	7.59	4.95	..
Av. No. days with Precipitation ..		3	3	2	3	3	3	6	7	4	3	2	2	41	26	23
Av. Snowfall, in..		2.0	1.7	0.7	T.	0	0	0	0	0	0.4	0.6	1.8	7.2		15
Temperature																
Mean		33.8	39.3	47.2	55.7	64.7	73.4	77.1	75.3	67.8	56.6	43.3	34.4	55.7		33
Mean Max.		48.1	53.1	63.3	71.2	78.9	89.1	90.4	88.3	81.8	71.0	57.9	47.7	70.1		18
Mean Min.		22.3	27.0	32.8	40.8	48.6	57.8	62.1	60.6	53.4	41.5	30.1	22.2	41.6		18
Highest		70	78	89	89	95	104	104	99	97	86	78	69	104		18
Lowest		–4	–10	12	12	30	37	44	45	30	24	7	3	–10		18
Prevailing wind..		N	NW	W	ssw	S	S	S	S	S	S	S	N	S		23
Days clear........		20	17	18	18	20	20	14	14	19	21	22	19	222	105	23
Days partly cl'dy		7	7	9	9	8	9	15	14	9	6	6	8	107	64	23
Days cloudy......		4	4	4	3	3	1	2	3	2	4	2	4	36	14	23

Frost:— Average date of first killing frost in autumn, Oct. 23.
Average date of last killing frost in spring, April 16.
Earliest date of killing frost in autumn, September 17.
Latest date of killing frost in spring, May 15.
Average length of growing season, 191 days.
Years Recorded, 23.

*Estimated from nearby stations.

This is a north-central county, and the smallest in the state. The altitude is approximately from 4,500 to 6,000 feet, with a considerable mountain area east of the Rio Grande.

The valley of the Rio Grande has an average annual precipitation of less than 8 inches; mean annual temperature, 55.7 degrees; maximum at times above 100 degrees and minimum as low as 10 degrees below zero, at long intervals; rather fresh southerly winds and much clear sky. Precipitation increases rapidly with altitude and probably exceeds 15 inches at 8,000 feet. Seasonal precipitation is from April to September, inclusive.

Average annual precipitation 8 inches to 16 in mountains.

Average seasonal precipitation 5 inches to 13 in mountains.

Average seasonal snowfall 7 inches to 30 or more in mountains.

Mean annual temperature 50 degrees to 56 degrees.

Mean summer temperature 70 degrees to 75 degrees.

Mean winter temperature 30 degrees to 36 degrees.

Almost all of the farming in this county is being done in the Rio Grande valley under irrigation; and considerable fruit, such as apples, pears, peaches, European and native plums, sour cherries and grapes, is being raised. Alfalfa, wheat, barley, oats, sorghums, corn, carrots, turnips, watermelons, tomatoes, celery, cauliflower, spinach, onions, cabbage, chile and beans are among the most successful crops raised. Potatoes have not proven a success. In the eastern and mountainous section some dry farming is being done, and beans, watermelons, pumpkins, short season corn, and some Irish potatoes are the principal crops grown. There is not sufficient rainfall, as a rule, in the western part of the county, nor in the valley, to insure the growing of crops, at least on a large scale, under dry farming conditions.

Stock raising flourishes on the mesas and in the mountains of the eastern, northern and northwestern portions of the county.

CHAVES COUNTY

STATION—BOAZ. APPROX. LATITUDE—33° 45′. LONGITUDE—103° 55′. ELEVATION—4154 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Precipitation	1909	....	....	....	0	0.02	4.55	1.57	1.60	0.27	0.21	1.28	0.32	.....	8.01	
	1910	0.11	0.02	0.06	0.06	0.28	0.74	0 63	3.81	0.97	0.36	0.06	0.07	7.17	6.49	
	1911	0.07	0.96	0.21	2.04	3.12	0.67	1.51	1.63	0.97	1.12	0.18	0.57	13.05	9.94	
	1912	0.01	0.25	0.21	0.07	0.72	1.81	0.64	3.53	2.61	1.31	0.10	0.43	11.69	9.38	
	1913	0.26	0.56	0.23	1 68	0.01	4.03	0.12	0.04	5.22	0.75	1.37	0.97	15.24	11.10	
	1914	0	0.06	0.05	1.33	3.08	2.71	3.21	1.38	0.20	2.29	1.25	1.04	16.60	11.91	
	1915	0.29	0.57	1.12	7.89	0.24	0.84	2 23	2.61	6.75	0.26	0.01	1.04	23.85	20.56	
	1916	0.26	0	0.37	1.07	0.20	0.22	2.32	10.06	1.12	3.05	0.10	0.47	19.24	14.99	
	1917	0.19	0.08	0 02	0	2.21	0	0.50	4.82	0.43	0	T.	0.00	8.25	7.96	
Average		0.15	0.31	0.28	1.77	1.10	1.73	1.41	3.28	2.06	1.04	0.48	0.55	14.38	11.35	
Days with precip.		2	2	3	4	4	6	5	7	4	3	3	4	47	30	
Snowfall, in......		1.2	2.1	1.4	0	0	0	0	0	0	0.4	0.9	3.9	9.9		
Temperature—																
Mean		40.8	41 2	49.0	57.4	65.8	74.3	78.0	76.1	69.7	57.8	48.2	36.6	57.9		
Mean Max.		57.9	58.6	66.9	75.1	83.2	90.4	93.8	91.3	85.3	74.8	65.2	51.0	74.5		
Mean Min.		23.8	23.7	31.0	39.7	48.4	58.2	62.3	60 9	54.1	40.8	31.1	22.3	41.4		
Highest		78	76	85	93	102	105	105	104	99	91	83	73	105		
Lowest		–20	–7	12	20	25	44	50	45	36	20	2	–9	–20		
Prevailing wind..		W	SW	SW	WSW	SW	SW	S	S	SW	SW	SW	SW	SW		
Days clear		21	15	20	17	17	15	12	13	20	23	23	19	215	94	
Days partly cl'dy.		7	10	8	11	12	13	17	17	8	5	4	6	118	78	
Days cloudy		3	3	3	2	2	2	2	1	2	3	3	6	32	11	

Frost—Average date of first killing frost in autumn, Oct. 18.
Average date of last killing frost in spring, April 24.
Earliest date of killing frost in autumn, Oct. 10.
Latest date of killing frost in spring, May 23.
Average length of growing season, 177 days.

CHAVES COUNTY

STATION—ROSWELL. APPROX. LATITUDE—33° 24′. LONGITUDE—104° 27′. ELEVATION—3578 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Precipitation	1889	.....	.....	....	....	.....	....	.....	....	....	2.55	3.15	0.05	.....	.....	
	1890	0.33	0.15	0.00	0.76	0.03	0.48	2.17	4.89	0.76	....	....	....	.....	9.09	
	1893	*0.11	0.74	....	0.00	.....	....	.....	....	....	....	....	....	.....	.....	
	1894	.....	.....	....	....	*2.00	1.33	0.48	2.49	0.57	0.04	0.00	0.50	.....		
	1895	0.40	0.48	0.02	0.14	2.31	1.28	4.45	2.99	1.09	2.11	0.88	0.07	16.22	12.26	
	1896	0.60	0.14	0.02	T.	0.12	1.97	1.79	0.40	1.98	5.46	0.00	0.64	13.12	6.26	
	1897	1.12	*0.05	0.59	1.35	3.76	1.42	2.78	2.54	1.25	0.44	T.	T.	15.30	13.10	
	1898	0.26	0.86	T.	0.34	1.03	6.05	6.53	2.99	0.69	T.	0.50	1.37	20.62	17.63	
	1899	0.06	0.15	0.06	0.23	0.27	1.62	4.37	1.21	3.64	0.20	3.21	1.54	16.56	11.34	
	1900	0.96	T.	0.50	0.39	1.62	2.13	2.85	1.25	6.53	3.33	0.17	0.07	19.80	14.77	
	1901	0.21	1.15	0.00	0.97	1.04	0.22	3.04	0.60	1.99	2.21	6.15	0.26	17.84	7.86	
	1902	1.24	0.00	0.83	T.	0.70	1.03	5.52	1.80	3.08	1.36	0.52	0.50	16.58	12.13	
	1903	0.22	0.96	0.10	T.	0.74	4.37	*0.50	0.36	0.92	T.	0.00	0.00	8.17	6.89	
	1904	0.16	0.14	0.00	0.07	1.30	1.80	1.23	0.83	5.10	2.76	0.15	0.60	14.05	10.33	
	1905	0.55	2.62	2.95	1.87	0.01	1.78	4.97	0.01	0.64	0.37	2.40	1.06	19.23	9.28	
	1906	0.53	0.47	0.24	2.70	0.46	0.42	2.30	1.83	0.48	0.73	4.06	0.99	15.21	8.19	
	1907	0.36	0.00	0.00	0.64	1.15	2.03	1.74	2.06	0.96	2.98	1.36	0.15	13.42	8.58	
	1908	0.26	0.28	0.01	1.29	0.07	0.68	2.16	2.87	1.29	T.	0.70	0.01	9.62	8.36	
	1909	0.02	0.02	0.97	0.00	0.05	1.05	1.94	2.01	0.40	0.63	0.29	0.31	7.69	5.45	
	1910	0.10	0.11	0.05	0.08	0.15	0.75	0.57	2.03	0.44	0.36	0.22	0.01	4.87	4.02	
	1911	0.14	1.92	0.29	2.16	3.38	0.45	2.93	1.23	1.71	1.14	0.46	0.56	16.37	11.86	
	1912	0.03	1.32	0.04	0.15	0.34	1.21	1.94	2.80	2.67	0.87	0.43	1.10	12.90	9.11	
	1913	0.60	0 55	0.74	1.21	0.03	4.17	0.82	0.28	2.67	0.85	0.97	0.88	13.77	9.18	
	1914	0.04	0.11	0.14	1.14	3.77	1.45	1.97	1.33	0.05	3.37	0.30	1.78	15.45	9.71	
	1915	0.38	0.95	1.85	6.04	1.18	0.14	0 45	1.77	2.29	0.12	T.	0.99	16.16	11.87	
	1916	0.44	T.	0.58	1.11	0.17	0.44	1.04	9.56	0.37	2.31	0.44	0.36	16.82	12.69	
	1917	0.19	0.26	0.29	0.00	0.97	T.	0.07	3.25	1.11	0.01	0.06	0.00	6.21	5.40	
Mean		0.39	0.54	0.43	0.98	1.07	1.53	2.34	2.14	1.71	1.36	1.06	0.55	14.13	9.77	
Days with precip.		2	2	2	2	4	6	8	5	5	4	3	2	45	30	12
Snowfall, in.		2.0	3.7	0.8	0.4	0	0	0	0	0	T.	1.3	3.1	11.3		21
Temperature																
Mean		39.2	42.5	51.3	60.6	69.4	76.3	78.9	76.6	70.3	59.5	48.1	41.2	59.5		14
Mean Max.		56.8	58.9	70.7	77.5	84.2	90.7	90.8	90.8	85.2	74.9	64.6	55.6	75.1		16
Mean Min.		24.4	25.4	34.7	41.4	51.2	59.1	63.3	62.3	54.9	42.0	31.4	24.2	42.9		16
Highest		83	88	91	94	99	110	106	103	101	93	87	77	110		20
Lowest		−19	−14	−2	20	29	45	53	48	33	19	10	−10	−19		20

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Prevailing wind..		SW	SW	SW	SW	SW	SE	SE	SE	SW	SW	SW	SW	SW		10
Av. hourly veloc..		6	7	8	7	7	6	5	5	5	5	6	6	6		
Days clear		17	15	16	17	16	14	13	15	17	21	20	16	197	92	
Days partly cl'dy.		8	8	9	8	11	12	13	12	9	6	6	9	111	65	
Days cloudy		6	5	6	5	4	4	5	4	4	4	4	6	57	26	
Mean Rel. humidity, 6 a. m......		79	76	69	70	67	74	80	84	85	81	81	81	77		
Mean Rel. humidity, 6 p. m......		44	39	31	29	26	35	41	45	46	48	53	53	41		
Percentage of sunshine		67	66	67	69	74	73	68	70	74	74	69	61	69		

Frost—Average date of first killing frost in autumn, Oct. 21.
Average date of last killing frost in spring, April 11.
Earliest date of killing frost in autumn, Oct. 10.
Latest date of killing frost in spring, May 6.
Average length of growing season, 193 days.
Years recorded, 16.

*Estimated from nearby stations.

This is one of the most notable southeastern counties, with altitude increasing westward from the Pecos Valley, from 3,500 to 5,000 or 6,000 feet, and eastward rarely going much above 4,500 feet. It has a warm, rather dry, climate, affording bountiful crops in the irrigated valley of the Pecos, and good grazing lands over the mesas east and west. The seasonal rainfall exceeds 9 inches (from April to September, inclusive) in the valley and increases to about 11 inches over the eastern mesas, amounting to more than 14 inches annually in both districts. The mean temperature is about 60 degrees in the valley and 58 degrees over the mesas, with maximum slightly above 100 degrees practically every summer and minimum occasionally below zero each winter. Much sunshine occurs and rather fresh southwesterly winds.

Average annual precipitation, 14 to 16 inches.
Average seasonal precipitation, 10 to 12 inches.
Average seasonal snowfall, 10 to 15 inches.
Mean annual temperature, 58 to 60 degrees.
Mean summer temperature, 75 to 77 degrees.
Mean winter temperature, 39 to 41 degrees.
Mean annual sunshine, 69 per cent.
Mean relative humidity, 59 per cent.
Prevailing wind direction, southwesterly.
Average hourly wind movement, 6.8 miles.

Practically all of the farming is done in the Pecos Valley; both under artesian well and gravity irrigation. Alfalfa is the principal forage crop, although the feed sorghums do very well. Kafir, feterita, milo, and Indian corn, are successfully grown. Among the vegetables, sweet potatoes, cantaloupes, cabbage, onions, tomatoes, and celery, as well as a number of the root crops, are well adapted. This is the largest apple growing county in the state. Large apple orchards are in bearing and a number are coming into bearing. While apples are the principal fruit crop, American and European plums, sour cherries, as well as peaches and grapes, are also grown. The Irish potato is not a complete success, and should not be planted on a large scale. On account of the limited amount of rainfall crops are not successfully grown under dry farming

conditions in most years in the greater part of the county, although in the northeastern part the non-saccharine sorghums, broom corn, beans, and such vegetables as pumpkins, squash and melons grow very well.

Stock raising is carried on extensively on the mesas and in the mountains; while in the irrigated valleys the feeding of sheep, both lambs and old ewes, by the farmers, and the growing of pork by means of pasturing on alfalfa, are coming industries.

COLFAX COUNTY

STATION—CIMARRON. APROX. LATITUDE— 36° 55′. LONGITUDE—104° 53′. ELEVATION—6 385 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Precipitation	1904	.....	.....	....	....	2.34	1.88	2.25	1.21	7.65	0.57	0.19	0.29	.....	.....	
	1905	0.26	0.83	5.42	4.45	0.83	0.52	2.88	1.51	2.52	0 28	1.80	0.04	21.34	12.71	
	1906	0.05	0.25	0.41	1.15	0.34	1.10	4.06	2.26	2.52	1.17	0.66	0.84	14.81	11.43	
	1907	0.32	0.06	T.	1.73	2.32	0.75	2.70	3.56	0.04	0.74	0.87	T.	13.09	11.10	
	1908	0.06	0.40	0.27	1.67	1.25	0.18	2.00	2.71	0.09	0.65	0.62	0.20	10.10	7.90	
	1909	0.22	0.08	0.78	0.62	1.33	0.45	1.70	2.24	3.74	0 49	1.01	1.14	13.80	10.08	
	1910	0.10	0.20	0.14	1.54	0.72	2.17	1.41	2.27	0.27	1.66	0.24	T.	10.72	8.38	
	1911	0.02	0.13	0.56	0.39	2.61	2.44	5.68	3.28	1.88	2.96	0.31	1.69	22.95	16.28	
	1912	T.	0.48	1.97	0.67	2.31	2.66	1.36	2.20	1.14	1.25	0.00	0.11	14.15	10.34	
	1913	0.44	1.85	0.95	1.19	0.95	5.20	1.22	1.75	2.17	0.39	0.53	2.13	18.77	12.48	
	1914	0.01	0.28	0.43	5.40	2.80	1.11	6.72	3.83	0.45	2.34	0.40	0.22	23.99	20.31	
	1915	0.13	1.26	1.10	5.48	2.33	1.75	3.73	1.39	2.08	0.97	0.03	0.33	20.58	16.76	
	1916	0.87	0.00	0.21	3.89	0.24	2.33	1.83	3.11	0.26	1.65	0.03	0.17	14.59	11.66	
	1917	0.55	0.77	0.09	1.17	2.56	0.74	2.14	2.14	0.47	0.43	0.36	T.	11.42	9.22	
Average		0.23	0.58	0.95	2.10	1.64	1.73	2.84	2.39	1.81	1.11	0.50	0.55	16.43	12.51	
Av. No. days with precipitation ..		1	3	5	7	7	8	12	12	7	4	3	2	71	53	12
Av. snowfall, in..		1.8	8.2	7.6	5.2	3.2	0	0	0	T.	3.2	4.7	7.0	40.9		11
Temperature—																
Mean		33.8	33.7	41.2	48.0	54.9	63.2	67.0	65.2	59.9	49.8	40.4	30.1	48.9		10
Mean Max.		49.3	49 0	57.1	63.4	71.0	79.1	81.4	81.0	76.6	66.5	57.4	45.7	64.8		11
Mean Min.		17.6	17.3	25.7	32.4	38.3	47.1	52.2	51.4	43.6	33.2	24.2	15.0	33.2		11
Highest		70	71	81	82	86	92	92	91	87	85	78	73	92		11
Lowest		−20	−35	−11	11	18	31	40	36	23	1	−6	−16	−35		11
Prevailing wind..		E	E	W	E	SE	SE	SE	SE	SE	E	E	E	E		12
Days clear		16	12	12	12	11	11	7	9	15	18	17	16	156	65	12
Days partly cl'dy.		9	9	11	10	12	13	17	17	10	7	6	8	129	79	12
Days cloudy		6	7	8	8	8	6	7	5	5	6	7	7	80	39	12

Frost—Average date of first killing frost in autumn, Oct. 6.
Average date of last killing frost in spring, May 7.
Earliest date of killing frost in autumn, Sept. 19.
Latest date of killing frost in spring, May 17.
Average length of growing season, 152 days.
Years recorded, 12.

COLFAX COUNTY

STATION—RATON. APPROX. LATITUDE—36° 54′. LONGITUDE—104° 25′. ELEVATION—6,660 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Precipitation	1894	....	....	0.27	0.78	3.05	....	....	....	....	....	....	0.28	....	....	
	1895	0.07	0.20	T.	0.40	2.65	1.82	4.97	0.12	0.00	0.03	0.27	0.60	11.13	9.96	
	1896	0.13	2.05	T.	2.03	0.00	0.14	1.08	1.06	1.14	0.09	T.	0.25	7.97	5.45	
	1897	0.20	0.51	0.40	0.20	4.08	2.12	0.10	0 36	0.11	3.57	0.00	0.10	11.75	6.97	
	1898	0.20	T.	0.00	0.49	1.57	3.00	4.00	3.00	0.11	1.00	0.40	0.20	13.97	12.17	
	1899	T.	0.20	0.40	0.05	0.56	1.85	7.47	0.25	4.17	0.25	1.10	0.36	16.66	14.35	
	1900	0.15	0.88	T.	6.00	2.55	1.10	0.96	1.40	1.70	1.35	0.00	0.40	16.49	13.71	
	1901	0.60	0.80	1.15	0.86	1.85	0.10	2.20	1 80	0.50	0.00	0.00	0.55	10.41	7.31	
	1902	0.25	0.80	1.50	1.18	1.19	0.30	0.08	3.50	0.01	0.00	0.11	0.22	8.14	5.26	
	1903	0.00	2.10	0.05	0.00	0.02	9.44	0.02	2.12	0.20	T.	0.01	0.25	14.21	11.80	
	1904	0.30	0.00	0.40	0.60	0.73	1.25	1 60	*2.35	7.38	0.60	0.05	0.20	*15.46	13.91	
	1905	0.40	0.85	2.45	2.12	1.62	0.10	1.84	1.45	0.11	0.35	*2.04	0.08	*13.41	7.24	
	1906	0.03	0.56	0.40	0.45	....	....	....	....	....	....	....	....	....	....	
	1909	0.10	0.15	0.95	0.75	3.00	1.07	2.13	5.11	6.30	1.14	1.27	1.35	23.32	18.36	
	1910	0.18	0.20	0.15	2.38	2.15	0.41	2.21	4.98	0.49	0.46	0.35	0.24	14.16	12.62	
	1911	0.10	1.43	0.50	0.62	2.79	1.81	5.92	2.49	1.18	3.24	*0.48	1.32	*21.88	14.81	
	1912	0.12	0.86	0.90	2.63	2.45	3.87	1.64	1.93	1.83	0.52	T.	T.	16.75	14.35	
	1913	0.06	1.70	0.47	1.30	0.71	8.35	2.02	1.54	1.63	0.92	0.29	2.72	21.71	15.55	
	1914	0.01	0.09	0.22	4.19	4.32	1.32	11.35	1.19	0.00	0.73	0.00	0.27	23.69	22.37	
	1915	0.25	0.76	0.58	5.84	3.69	0.44	7.15	2.31	1.72	0.48	0.38	0.21	23.81	21.15	
	1916	0.47	T.	T.	1.09	0.07	0.62	3.07	4.49	0.03	2.08	0.04	0.16	12.12	9.37	
	1917	0.43	0.35	0.20	1.09	1.33	1.54	0.71	2.59	4.93	0.17	1.82	0.10	15.26	12.19	
Average		0.19	0.69	0.50	1.55	1.92	2.03	3.03	2.20	1.68	0.85	0.43	0.49	15.56	12.41	
Av. No. days with precipitation ..		2	3	3	4	5	6	6	6	3	3	1	3	45	31	15
Av. snowfall, in..		1.8	8.2	4.3	5.3	0.8	T.	0	0	0.1	1.0	1.8	5.7	29.0		19
Temperature—																
Mean		32.6	32.3	40.0	48.2	56.6	64.8	68.8	68.1	61.3	50.5	41.6	31.3	49.7		19
Mean Max.		47.1	46.7	55.1	63.7	72.3	81.3	85.0	84.4	77.5	67.0	57.1	47.0	65.4		18
Mean Min.		17.5	17.9	24.4	32.3	40.7	48.0	52.8	51.7	44.3	34.7	27.1	16.0	34.0		18
Highest		75	72	87	90	99	97	98	98	92	91	82	72	99		18
Lowest		–14	–18	–7	9	18	30	30	38	26	3	–1	–12	–18		18

COLFAX COUNTY, (Continued)

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Prevailing wind..		N	NW	S	S	S	S	S	NW	S	SW	S	NW	S		15
Days clear		20	17	17	17	17	17	18	17	20	19	22	21	222	106	20
Days partly cl'dy.		7	7	8	7	7	8	8	8	5	6	4	5	80	43	20
Days cloudy......		4	4	6	6	7	5	5	6	5	6	4	5	63	34	20

Frost—Average date of first killing frost in autumn, Oct. 3.
Average date of last killing frost in spring, May 4.
Earliest date of killing frost in autumn, Sept. 12.
Latest date of killing frost in spring, May 23.
Average length of growing season, 150 days.

*Estimated from nearby stations.

This is one of the northeast border counties, with many miles of mesa land from 5,500 to 9,000 feet in altitude, but rising along its western border at the crest of the Sangre de Cristo range to 13,000 feet. The mesa districts average from 14 to 16 inches in annual precipitation at 6,000 feet, increasing to 16 or 18 inches at 8,000 feet, and going above 20 inches at 10,000 feet. Over the lower mesas, which are successful dry farming lands, more than 12 inches precipitation occurs during the growing season from April to September. The temperature averages about 50 degrees, with maximum each summer above 90 degrees, and minimum each winter well below zero, with an occasional extreme record of 20 to 30 degrees below, especially over the mountain areas. In these districts the growing season is short, climate rigorous, snows heavy and winter long. The mesa districts have fresh, southerly winds, dry, sunshiny climate, with rather late spring frosts—conditions which are rather more favorable for grazing, although there are extensive dry farming areas.

Average annual precipitation, 13.5 to 16 or 18 inches in mountains.

Average seasonal precipitation, 9.5 to 13 or 14 inches in mountains.

Average seasonal snowfall, 25 to 40 inches and to 80 inches in the mountains.

Mean annual temperature, 48 to 50 degrees.

Mean summer temperature, 65 to 70 degrees.

Mean winter temperature, 32 to 33 degrees.

Crops are grown at all of the altitudes between 5,500 and 9,000 feet, both under dry farming and irrigation. In the high mountain altitudes, between 7,500 and 9,000 feet, particularly on the Johnson Mesa and in the Moreno Valley, excellent Irish potatoes are raised; also oats, barley and wheat. While these are the principal crops in these high altitudes, cabbage, carrots, turnips and celery may also be raised. A large part of the agriculture is carried on by dry farming methods. By reason of the favorable climatic and soil conditions, all of the farming on these mesas is being done in this manner. In the irrigated intermontane districts along the Poño River, Red River, Rayado, Cimarron and Cimarroncito the farming is all under irrigation, and there is a larger variety of crops raised; alfalfa, corn, beans, cane, wheat, barley, oats, cabbage,

onions, beets, carrots and turnips being among the leading crops. There is considerable fruit raised in these valleys, principally apples, although pears, sour cherries, and native and European plums are also raised. In the plains dry farming districts in the central and eastern parts beans, wheat, corn and cane are among the leading crops, in the lower altitudes.

Live stock raising is one of the principal industries, as the mesas, intermontane valleys and mountains afford excellent grazing conditions for both cattle and sheep.

CURRY COUNTY

STATION—CLOVIS. APPROX. LATITUDE—34° 24′. LONGITUDE—103° 11′. ELEVATION—4,129 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Precipitation	1911	.....	.....	....	....	....	....	3.39	2.23	1.67	1.01	0.25	1.56	.....	.....	
	1912	0	2.05	0.38	0.20	3.50	1.07	0.78	6.26	3.72	0	0	0.07	17.95	15.53	
	1913	0.21	0.82	0.04	1.61	0.12	5.39	1.62	1.62	1.69	0.76	0.91	1.16	15.95	12.05	
	1914	0	0.04	0.04	3.33	6.59	1.23	1.95	1.71	0.84	3.40	0.35	0.52	20.00	15.65	
	1915	0.25	1.01	1.38	6.77	0.54	1.41	3.81	2.85	5.74	1.38	0.22	1.53	26.89	21.12	
	1916	0.44	0	0.45	2.14	0.40	0.93	0.57	7.45	2.37	2.04	0.05	0.86	17.70	13.86	
	1917	0.44	0.06	0.07	0.57	1.13	0.00	2.35	1.77	1.10	0	0.07	0.00	7.56	6.92	
Average		0.22	0.66	0.39	2.44	2.04	1.67	2.07	3.41	2.45	1.23	0.26	0.95	17.79	14.08	
Av. No. days with precipitation ..		2	2	2	5	5	6	6	5	6	4	3	4	50	33	
Av. snowfall, in..		1.6	3.9	3.4	0.5	0	0	0	0	0	0.5	0.9	5.5	16.3		
Temperature—																
Mean		35.1	40.0	44.6	56.6	65.6	74.7	78.4	75.6	70.0	58.2	46.6	33.3	57.4		
Mean Max.		49.4	55.3	60.3	72.3	80.4	89.9	93.9	90.3	85.7	73.9	61.0	45.7	71.5		
Mean Min.		20.8	24.7	29.0	40.9	50.8	59.5	63.0	61.0	54.4	42.5	32.2	20.9	41.6		
Highest		68	79	85	91	99	106	108	106	101	92	84	71	108		
Lowest		–4	–4	2	12	28	38	53	48	35	13	8	–9	–9		
Prevailing wind..		W	W	W	W	W	S	SW	SW	SW	SW	SW	W	W		
Days clear		21	20	17	16	19	19	21	21	21	22	22	20	239	117	
Days partly cl'dy.		4	3	7	5	7	5	5	5	5	4	5	6	61	32	
Days cloudy......		6	5	7	9	5	6	5	5	4	5	3	5	65	34	

Frost—Average date of first killing frost in autumn, Oct. 31.
Average date of last killing frost in spring, April 19.
Earliest date of killing frost in autumn, Oct. 19.
Latest date of killing frost in spring, May 6.
Average length of growing season, 195 days.

This is an eastern border county, entirely rolling prairie lands, mostly 4,100 to 5,000 feet in altitude. Its precipitation averages about 15 to 18 inches a year, giving a seasonal average, from April to September, of about 14 inches. The temperature averages 57 degrees, with maximum above 100 degrees occasionally each summer, and to, or slightly below, zero each winter; while an occasional winter may have from 5 to 10 degrees below zero. Winds over these plains are fresh and prevailing westerly; much clear weather occurs, with a fairly long growing season.

Average seasonal snowfall, 15 to 20 inches.
Average annual precipitation, 15 to 18 inches.
Average seasonal precipitation, 13 to 14.5 inches.
Mean annual temperature, 55 to 57 degrees.
Mean summer temperature, 74 to 76 degrees.
Mean winter temperature, 36 to 39 degrees.

This is practically a dry farming county. Winter wheat, kafir, milo, feterita, broom corn, feed sorghums, Sudan grass, corn and beans are the principal crops raised. Melons, squash and pumpkins may also be raised under dry farming. Wherever water for irrigation may be had the soil can be depended upon for large yields of the crops grown under dry farming, as well as many of the vegetables and fruits. Some vegetable gardening is carried on by windmill irrigation, on a small scale. Rainfall is the limiting factor in the production of large yields in this county. A few fruit trees are planted for home use. Probably the better fruits to grow under the limited amount of rainfall would be some of the earlier ripening varieties, such as sour cherries, American plums and grapes.

Much of the prairie lands afford good pasture for sheep and cattle. On account of the favorable conditions for dry farming and the small size of the county, stock raising on the ranges is not very extensively carried on.

DE BACA COUNTY

STATION—FORT SUMNER. APPROX. LATITUDE—34° 28′. LONGITUDE—104° 15′. ELEVATION—3,960 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Precipitation	1864	....	....	.....	....	1.01	3.88	2.43	1.61	1.14	0.65	1.48	0.60	.....	.....	
	1865	0.23	1.32	0.45	0.07	0.38	1.50	10.63	4.37	1.07	3.65	0.03	3.57	27.27	18.02	
	1866	0.18	0.09	0.51	0.20	....	....	.....	....	0.35	0.52	0.80	0.10	.....	.....	
	1867	0.23	0.00	*6.97	0.43	0.54	0.70	0.80	0.50	3.15	0.70	0.00	*1.24	*9.26	6.12	
	1868	0.00	0.00	2.20	0.11	0.80	1.60	0.87	3.01	1.65	0.52	0.91	0.70	12.37	8.04	
	1869	0.52	0.31	0.72	0.99	2.51	2.09	1.16	....	....	....	....	.....	.....	.....	
	1908	....	....	.....	....	....	0.97	2.82	5.56	1.20	0.50	2.30	*0.13	.....	.....	
	1909	....	....	.....	....	0.16	1.62	1.06	1.70	0.48	0.10	....	0.12	.....	.....	
	1910	0.51	T.	0.33	0.34	T.	1.49	0.48	5.54	0.83	0.61	0.15	0.10	10.38	8.68	
	1911	0.30	1.63	0.45	2.39	1.72	0.19	2.11	1.55	0.43	....	....	.....	.....	8.40	
	1912	....	....	.....	....	....	....	.....	1.69	3.40	0.59	0.07	0.37	.....	.....	
	1913	0.16	0.34	0.09	2.56	0.03	4.87	0.36	0.52	1.73	0.59	1.75	1.34	14.34	10.07	
	1914	0.00	0.16	0.06	0.92	3.12	0.53	2.78	1.71	0.70	2.68	0.24	1.53	14.43	9.76	
	1915	0.34	1.42	1.58	3.77	0.07	0.34	1.63	1.46	1.31	0.69	T.	0.95	13.56	8.58	
	1916	1.33	0	0.35	1.70	0.30	0.01	1.22	2.53	0.82	0.98	0.62	0.59	10.45	6.58	
	1917	0.72	0.20	0.29	0.22	2.32	0.12	1.37	4.59	1.91	0.18	0.08	0.00	12.00	10.53	
Average		0.38	0.46	0.65	1.14	1.00	1.42	2.12	2.61	1.34	0.92	0.70	0.87	13.61	9.63	
Av. No. days with precipitation ...		1	3	2	4	3	8	7	8	5	4	4	4	53	35	6
Av snowfall, in...		2.1	2.2	1.3	1.2	T.	0	0	0	0	0	0	4.0	10.8		5
Temperature—																
Mean		39.5	40.2	48.0	56.4	64.5	74.6	77.2	76.0	68.0	55.8	46.8	35.5	56.9		5
Mean Max.		56.9	58.4	65.2	72.7	80.0	90.1	92.5	91.2	85.0	73.5	65.8	51.0	73.5		5
Mean Min.		22.1	22.1	30.7	40.0	49.1	59.1	62.0	60.8	51.0	38.0	27.8	20.1	40.2		5
Highest		78	88	87	94	96	104	106	106	100	92	85	76	106		5
Lowest		−22	−4	7	21	32	40	46	49	34	17	10	−8	−22		5

DE BACA COUNTY, (Continued)

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Prevailing wind..		SW	SW	SW	SW	SW	S	S	SW	SW	S	S	S	SW		5
Days clear		23	16	23	20	19	22	18	19	22	25	23	20	250	120	8
Days partly cl'dy.		5	8	4	7	8	6	11	10	6	4	4	4	77	48	8
Days cloudy		3	4	4	3	4	2	2	2	2	2	3	7	38	15	8

Frost—Average date of first killing frost in autumn, Oct. 19.
Average date of last killing frost in spring, April 8.
Earliest date of killing frost in autumn, Oct. 11.
Latest date of killing frost in spring, April 29.
Average length of growing season, 194 days.

*Computed from nearby stations.

This is an east central county, with the Pecos River passing through about the center, north and south. Most of the county is composed of upland, rolling mesas, from 4,800 to 5,300 feet in altitude. The precipitation of the valley is low, climate fairly hot, clear and breezy. The uplands show slightly greater precipitation and are favorable for grazing. The temperature averages about 57 degrees in the valley, and a little lower over the mesas, with maximum around 100, or a little above, at times each summer, and minimum to zero and occasionally 10 to 12 degrees below. The winds are fresh and prevailing southwesterly.

Average annual precipitation, 13.5 to 15 inches.

Annual seasonal precipitation, 9.5 to 12 inches.

Mean annual temperature, 55 to 57 degrees.

Mean summer temperature, 74 to 76 degrees.

Mean winter temperature, 36 to 38 degrees.

Farming is done under irrigation in the Pecos Valley, mostly around Fort Sumner, about 9,000 acres being irrigable under the present system. Alfalfa, corn, the sorghums, wheat, sweet potatoes, cantaloupes, beans, tomatoes and cabbage are among the leading irrigated crops. Considerable fruit is raised, principally apples. In other parts of the county milo, kafir and feterita, Pinto beans and small amounts of broom corn are usually raised by dry farming methods. There are no mountains or high altitude districts in the county.

About 97 per cent of the area of the county is devoted to stock raising under range conditions. In the western part of the county the sheep industry is important.

DOÑA ANA COUNTY

STATION—AGRICULTURAL COLLEGE. APPROX. LAT.—32° 45′. LONG.—106° 45′. ELEV.—3,863 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs
Precipitation	1851	.....	.....	....	....	....	....	....	....	1.40	0.11	2.13	1.74	.....	.....	
	1852	0.22	0.29	0.04	0.20	0.40	1.74	3.84	1.00	1.47	0.77	2.66	0.00	12.63	8.65	
	1853	0.04	0.10	0.03	0.01	0.05	0.28	2.80	1.83	1.21	0.90	1.15	0.64	9.94	6.18	
	1854	0.00	0.00	0.65	0.10	0.86	0.05	0 87	1.38	0.95	0.39	0.67	0.15	6.07	4.21	
	1855	0.00	0.00	0.12	0.45	0.10	0.07	2.63	1.29	2.31	0.09	0.45	0.00	7.51	6.85	
	1856	0.00	1 85	0.30	0.00	0.00	0.85	0.86	2.48	2.61	0.00	0.27	0.00	9.22	6.80	
	1857	0.30	0.95	0.00	0.26	0.00	0.00	0.43	3.68	2.24	2.41	0.00	0.13	10.40	6.61	
	1858	0.00	0.00	0.22	0.00	0.00	0.78	2 50	1.61	0.00	0.00	0.00	0.00	5.11	4.89	
	1859	0.00	0.14	0.00	0.00	0.00	0.00	1.18	1.15	1.59	0.30	1.16	0.00	5.52	3.92	
	1860	0.06	1.10	0.15	T.	0.00	0.30	1.10	T.	0.90	T.	T	0.00	3.61	2.30	
	1861	1.60	T.	0.00	0.00	T.	....	....	....	....	....	....	....	.....	.....	
	1865	.....	.....	....	....	....	....	....	....	....	....	0.00	1.00	.....	.....	
	1866	T.	T.	0.81	0.15	0.25	0.52	2.12	2.52	0.73	T.	0.52	0.17	7.79	6.29	
	1867	0.21	0 60	0.38	0.00	0.01	0.03	4.31	0.80	2.90	0.26	0.17	0.22	9.89	8.05	
	1868	0.67	0.02	0.08	0.12	1.13	0.01	2.00	1.79	1.68	0.38	0.33	1.50	9.71	6.73	
	1869	0.71	1.27	0.46	0.53	0.18	2.15	0 36	5.09	0.14	1.01	0.50	0.20	12.60	8.45	
	1870	0.00	T.	0.00	0.00	0.00	1.70	5.20	4.00	0.70	0.65	0.00	0.25	12.50	11.60	
	1871	T.	0 00	T.	0.00	0.22	0.60	2.30	1.05	2.75	T.	0.00	T.	6.92	6.92	
	1872	0.15	T.	0.00	T.	T.	0.09	1.19	0.85	1.10	0.25	0.00	2.70	6.33	3.23	
	1873	0.03	T.	T.	0.01	0.20	0.28	0.20	2.24	0.30	0.11	0.26	0.04	3.49	3.05	
	1874	0.59	0 55	0.26	0.62	0.01	0.18	0.39	1.10	0.35	0.62	0.71	0.75	6.13	2.65	
	1875	0.00	T.	T.	T.	T.	0.02	3.47	0.50	1.58	0.00	T.	0.12	5.69	5.57	
	1876	0.97	0.02	0.02	0.00	0.20	0.91	0.40	1.10	2.32	2.65	0.26	0.00	8.85	4.93	
	1877	0.01	4.46	....	....	....	....	....	0.01	0.91	0.98	0.06	0.41	.....	.....	
	1878	0.07	0 43	0.69	0.15	1.38	1.02	2.06	0.61	0.21	0.09	1.29	0.07	8.07	5.43	
	1879	1.20	0.62	0.31	0.03	0.00	0.03	1.87	1.02	0.18	0.78	0.00	1.26	7.30	3.13	
	1880	0.14	0.43	0.52	0.45	0.00	T.	1.92	1.03	1.02	0.35	0.13	1.11	7.10	4.42	
	1881	0.04	T.	0.14	0.09	1.75	0.43	3.90	3.13	1.96	2.14	0.56	0.91	15.05	11.26	
	1882	0.63	1.36	0.41	0.01	0.10	0.72	1.32	....	....	....	....	....	.....	.....	
	1886	T.	0.10	0.00	0.00	0.00	0.62	3.16	1.05	3.25	2.27	0.60	0.00	11.05	8.08	
	1887	0.10	0.30	0.00	0.00	0.58	0 20	0.68	2.64	1.94	0.74	0.00	0.24	7.42	6.04	
	1888	0.16	1.15	0.82	0.54	0.00	0.00	1.28	0.76	0.67	2.52	2.71	0.48	11.09	3.25	
	1889	1.30	0.51	0 20	0.04	0.08	0.74	0.59	0.26	1.62	1.06	0.67	0.00	7.07	3.33	
	1890	0.73	0.00	0.02	0.04	0.00	0.29	0.84	2.63	1.34	....	....	....	.....	.....	
	1892	0.67	0.36	0.46	0.08	T.	0 03	1.33	0.75	0.05	0.80	1.47	0.51	6.51	2.24	
	1893	0.07	1.26	0.02	0.00	0.77	0.00	2.04	4.19	2.39	0.03	0.03	0.02	10.82	9.39	
	1894	0.08	0.05	0 26	0.02	T.	T.	0.62	2.06	0.18	0.47	0.00	0.73	4.47	2.88	

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
	1895	0.45	0.24	0.01	0.00	0.52	0.10	3.03	2.19	0.96	1.20	0.45	0.32	9.47	6.80	
	1896	0.31	0.11	0.00	0.11	0.10	1.01	2.50	0.47	1.24	2.14	0.00	T.	7.99	5.43	
	1897	0.35	0.00	0.46	0.23	1.54	0.07	2.25	1.16	2.14	0.73	T.	0.03	8.96	7.39	
	1898	0.38	0.02	0 26	0.69	T.	1.83	2.18	2.43	1.74	T.	0.43	1.25	11.21	8.87	
	1899	0.05	0.09	0.19	0.13	T.	0.63	4.54	1.81	0.77	0.03	1.20	0.23	9.67	7.88	
	1900	0.33	0.42	1.36	0.31	0.88	0.16	1.52	0.90	1.80	0.45	0.23	0.04	8.40	5.57	
	1901	0.31	0.95	0.61	0.30	T.	1.08	2.23	1.35	1.25	2.85	0.98	0.05	11.96	6.21	
	1902	0.02	T.	0.05	0.00	0.01	0.07	2.16	5.77	1.22	T.	0.61	0.99	10.90	9.23	
	1903	0.20	0.98	0.37	0.08	0.10	3.65	0.97	1.50	2.43	0.00	0.00	0.01	10.29	8.73	
	1904	T.	0.11	0.00	0.00	0.05	0 70	1.36	1.24	4.02	1.52	0.50	0.63	10.13	7.37	
	1905	1.01	1.26	2.03	1.89	0.06	0.58	1.83	1.48	3.08	0.83	2.14	0.90	17.09	8.92	
	1906	0.81	0.68	0.13	0.50	0.40	T.	2.21	0.45	0.31	0.24	2.03	1.04	8.80	3.87	
	1907	0.74	T.	0.05	T.	0.22	0.58	0.75	1.42	1.16	0.57	0.93	0.00	6.42	4.13	
	1908	0.38	0.65	0.17	0.27	0.22	0.00	1.99	1.33	0.03	0.22	0.65	0.06	5.97	3.84	
	1909	0.01	0.09	0.89	0.00	T.	0.55	0.71	1.11	0.92	0.18	0.00	0.48	4.94	3.29	
	1910	0.22	0.02	0.33	0.10	T.	0.25	1.10	1.46	0.23	0.03	0.11	0.17	4.02	3.14	
	1911	0.27	0.78	0.60	0.32	0.10	0 33	1.36	0.14	1.18	0.30	0	.42	5.80	3.43	
	1912	T.	0.08	0.30	0.80	0.08	0.12	0.48	5.04	0.70	0.98	0.32	0.30	9.26	7.22	
	1913	0.49	0.80	0.20	1.40	0.01	2.63	1.27	1.33	1.70	T.	0.80	1.10	11.73	8.34	
	1914	0.10	0.16	0.10	T.	0.32	1.85	2.08	1.48	0.92	0.54	0.56	3.74	11.85	6.65	
	1915	0.64	0.59	1.23	0.11	0	T.	1.24	1.32	2.11	0.01	T.	0.12	7.37	4.78	
	1916	0.25	0.18	0.67	0.07	0.97	0	0.50	1.28	0.69	2.50	0.52	0.15	7.78	3.51	
	1917	0.19	T.	0.01	0 01	0.34	T.	1.31	3.09	0.51	T.	0.12	T.	5.58	5.26	
Average		0.32	0.44	0.31	0.20	0.24	0.55	1.76	1.70	1.33	0.69	0.56	0.50	8.60	5.78	
Av. No. days with precipitation ...		2	3	3	2	1	3	8	8	5	3	2	3	43	27	
Av. snowfall, in..		0.5	0.4	0.6	0.1	0	0	0	0	0	0	0.6	0.9	3 1		
Temperature—																
Mean		42.6	45.4	52.4	59.1	65.6	76.4	79.2	78.0	71.6	60.2	49.7	41.4	60.2		17
Mean Max.		59.2	61.7	69.5	76.8	85 4	94.1	93.9	92.7	87.2	77.6	66.8	65.4	76.8		17
Mean Min.		25.9	29.2	35.4	41.4	45.7	58.6	64.6	63.4	56.1	42.8	32.6	26.3	43.5		17
Highest		77	86	90	94	99	106	106	105	101	92	82	77	106		17
Lowest		−8	2	14	22	27	36	51	47	33	22	7	3	−8		17
Prevailing wind..		W	W	W	W	W	W	SW	SE	SE	*	SE	N	W		17
Av. hrly. velocity		6	7	9	9	8	7	6	6	6	6	6	6	7		

*Prevailing wind for October, SE., SW., W.

DOÑA ANA COUNTY, (Continued)

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Days clear		19	15	18	20	21	20	12	13	18	21	20	18	215	104	
Days partly cl'dy.		8	8	8	7	8	9	14	14	8	6	6	7	103	60	
Days cloudy		4	5	5	3	2	1	5	4	4	4	4	6	47	19	
Mean rel. humid..		52	52	46	42	40	42	54	59	56	55	53	51			

Frost—Average date of first killing frost in autumn, Oct. 22.
Average date of last killing frost in spring, April 12.
Earliest date of killing frost in autumn, Oct. 1.
Latest date of killing frost in spring, May 22.
Average length of growing season, 193 days.
Record in year 17.

NOTE—From September, 1851, to May, 1861, the values given are for Fort Fillmore, about ten miles southeast of State College; from November, 1865, to February, 1877, and from January, 1886, to September, 1890, the values given are for Fort Selden, about eighteen miles northwest of State College; from August, 1877, to July, 1882, they are for La Mesilla, about three miles west of State College.

This is a southern border county, traversed from north to south by the Rio Grande, with a narrow strip along the stream below 4,000 feet, but largely 4,000 to 5,000 feet in altitude, rising abruptly along its eastern border to the Organ Mountains and San Andres range. It is a warm, dry, sunshiny district. The precipitation for 66 years averages between 8 and 9 inches annually along the Rio Grande, and is slightly higher over the mesas and foothills, affording sparse grazing lands. The mean temperature of the lower districts is about 60 degrees, with maximum well above 100 degrees each summer and minimum toward zero each winter; which, however, is usually clear, dry and pleasant. Rather fresh westerly winds prevail.

Average annual precipitation, 8 to 10 or 12 inches.

Average seasonal precipitation, 5.5 to 7.5 inches.

Average seasonal snowfall, 3 to 10 inches, with 15 to 20 inches in mountains.

Mean annual temperature, 60 degrees.

Mean summer temperature, 78 degrees.

Mean winter temperature, 43 degrees.

Average hourly wind movement, 7 miles.

Prevailing direction of wind, westerly.

Mean relative humidity, 51 per cent.

All of the farming done in this county is by irrigation. As the rainfall is very light there is no dry farming being carried on. The Mesilla Valley is located in about the center of the county, and is under the Elephant Butte Irrigation Project. About 90,000 acres of land can be irrigated from this reservoir. Almost any of the temperate zone crops can be raised here, but the principal ones are alfalfa, corn, wheat, oats, barley, feed and grain sorghums, Sudan grass and field peas. Among the leading cool season vegetables are early cabbage, onions, spinach, asparagus, garden peas, table beets, carrots, turnips, and radishes; while among the warm season vegetables are the sweet potato, tomato, chile, cantaloupe, watermelon, beans, sweet corn and eggplant, which are well suited to both the soil and climatic conditions. The Irish potato, as a rule, is not dependable, and should not be grown on a large scale until more information is obtained regarding its adaptability here.

Peaches, grapes (mostly the European varieties), apples, pears, quinces, European and native plums and sour cherries are raised. Sweet cherries are not considered a success. Almonds, Japanese plums and apricots are failures on account of the fact that they bloom so exceedingly early in the spring they are killed by the frost.

The mesas west of the Rio Grande, as well as those east, the Organ Mountains and San Andres range afford considerable grazing for cattle, while the northern part of the county affords good range for sheep. The raising of hogs is becoming an important industry in the Mesilla Valley. Sheep are also being raised on the farms.

EDDY COUNTY

STATION—CARLSBAD. APPROX. LATITUDE—32° 24′. LONGITUDE—104° 10′. ELEVATION—3,120 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs
Precipitation	1889	.....	.....	....	....	....	....	.....	0.91	2.11	1.59	....	.....	.....		
	1891	....	....	....	....	....	....	....	....	0.14	0.00	....	0.38	....		
	1894	.....	.....	....	....	0.13	2.46	1.02	6.57	1.38	*T.	0.00	0.20	.....		
	1895	0.65	0 19	0.00	0.10	2.11	0.57	4.50	2.09	0.31	1.80	0.56	0.04	12.92	9.68	
	1896	0.14	0.68	0.00	0.00	0.00	2.57	1 02	0.65	2.87	2.22	0.00	0.82	10.97	7.11	
	1897	0.41	0.00	0.33	0.43	1.52	0.66	0.50	5.04	0.76	0.20	T.	T.	9.85	8.91	
	1898	0.15	0 20	0.55	0.70	1.25	5.51	4.35	1.61	0.60	0.00	0.30	1.70	16.92	14.02	
	1899	0.00	0.20	0.70	1.00	*T.	1.60	1 00	*T.	0.95	0.30	2.10	*1.55	9.30	4.55	
	1900	.....	*T.	0.50	....	....	....	.....	....	....	....	....	.....	.....	.....	
	1901	.....	.....	....	....	....	....	2.86	1.35	1.11	2.94	0.22	0.20	.....	.....	
	1902	0.30	0.00	0.22	*T.	0.14	3.54	10 50	4.02	1.02	1.43	0.57	0.68	22.42	19.22	
	1903	0.33	0.35	*T.	0.51	*T.	4.55	0 00	0.48	1.83	0.00	0.00	0.00	8.05	7.37	
	1904	0.16	0.11	0.00	0.00	0.57	5.13	0.64	3.99	4.55	1.71	0.96	0.28	18.10	14.88	
	1905	0.92	2 00	3.39	2.07	0.56	2.06	3.86	1.85	2.08	1.01	1.43	0.64	21.87	12.48	
	1906	0 67	0.68	0.20	3.46	0.49	0.92	6.89	1.32	1.37	0.45	3.43	0.98	20.86	14.45	
	1907	0.10	0.00	*T.	0.05	0.34	1.46	1.71	2.81	*T.	8.68	1.22	0.05	15.82	6.37	
	1908	0.33	*T.	0.38	0.68	*T.	1.69	7.20	1.98	0.95	*T.	0.37	*T.	13.58	12.50	
	1909	0.05	*T.	0.04	0.00	0.02	0.57	3.66	1.67	1.00	0.19	0.38	0.50	8.08	6.92	
	1910	0.09	0.00	0.04	0.12	0.20	0.02	0.91	1.55	0.48	0.34	0.12	0.08	3.95	3.28	
	1911	0.54	1.82	0.50	1.75	1.35	1.01	5.97	1.23	1.16	0.33	0.20	0.96	16.82	12.47	
	1912	0	0.45	0.30	0.54	0 19	2.72	0.93	1 93	3.18	0.77	0.85	0.82	12.68	9.49	
	1913	0 18	0.28	0.97	1.33	0.14	3.93	0.70	0.84	3.93	1.03	1.21	0.79	15.33	10.87	
	1914	0.07	0.20	0.30	0.67	1.08	3.74	4.73	0.46	1.38	1.95	1.24	3.22	19.04	12.06	
	1915	0.44	0.80	2.15	5.04	0.28	1.36	1.14	1.26	5.40	0.12	0	0.58	18.57	14.48	
	1916	0.30	0.12	0.10	1.34	0.06	*T.	5.63	6 83	0.30	4.52	0.55	0.12	19.87	14.16	
	1917	0.20	0.00	0.48	*T.	0.64	0.17	0.05	2.19	1.50	0.00	0.50	0.00	5.73	4.55	
Mean		0.29	0.38	0.51	0.94	0.50	2.10	3.03	2.20	1.61	1.24	0.70	0.61	14.11	10.38	
Av. No. days with precipitation ...		2	2	2	3	2	5	7	6	5	3	3	3	43	28	
Av. snowfall, in..		1.4	1.5	0.5	0	0	0	0	0	0	0	0.9	1.6	5.9		
Temperature—																
Mean...........		45.4	47 2	56.4	63.2	71.7	78.9	80.4	79.8	73.6	63.0	52.8	43.3	63.0		
Mean Max.		62.4	64.5	74.6	81.0	89.1	95.1	94.9	94.4	88.4	79.9	70.7	59.4	79.5		
Mean Min.		28.3	29 8	38.1	45.4	54.3	62.7	65.8	65.1	58.8	46.1	34.8	27.1	46.4		
Highest		88	100	97	100	105	112	110	108	104	100	97	85	112		
Lowest		−3	−2	15	24	31	45	53	49	33	22	2	0	−3		

EDDY COUNTY, (Continued)

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs
Prevailing wind..		SE	SE	SE	SE	SE	SE	SE	SE	SE	SE	SE	SE	SE		
Days clear		20	18	21	21	20	19	17	17	19	20	21	19	232	113	
Days partly cl'dy.		7	6	6	5	9	8	10	11	5	7	5	7	86	48	
Days cloudy		4	4	4	4	2	3	4	3	6	4	4	5	47	22	

Frost—Average date of first killing frost in autumn, Oct. 30.
Average date of last killing frost in spring, March 29.
Earliest date of killing frost in autumn, Oct. 16.
Latest date of killing frost in spring, May 7.
Average length of growing season, 207 days.

*Computed from nearby stations.

This is a southeastern border county, varying from 3,000 to 4,000 feet in altitude along the lower Pecos, which traverses it from north to south. Portions of the county along its western border, however, are broken and mountainous, while east of the river some distance there is a rise to the "cap rock." As a whole it is a warm, dry, sunshiny district, with an annual precipitation of about 14 inches, which increases to 18 and possibly 20 inches over the mountains in its southwestern border; mean annual temperature 60 to 63 degrees, with maximum well above 100 degrees each summer and about zero each winter. The winds of the valley are light, south to southeast, but are fresh over the mesas east and west. A long, hot growing season obtains, but one requiring irrigation for most successful culture.

Average annual precipitation, 13 to 15 inches, and to 18 in the mountains.

Average seasonal precipitation, 10 to 12 inches.

Average seasonal snowfall, 5 to 10 inches, and 20 to 30 inches in the mountains.

Mean annual temperature, 60 to 63 degrees.

Mean summer temperature, 78 to 80 degrees.

Mean winter temperature, 42 to 46 degrees.

Practically all of the agriculture in this county is carried on under irrigation. Alfalfa, wheat, barley, oats, cotton, corn, milo, kafir, feterita, the feed sorghums, sweet potatoes, beans, and onions are some of the leading crops raised under the Carlsbad Reclamation Project. Apples are not successfully grown under the project, although in the Artesia valley and in the Hope district there are a number of commercial apple orchards which produce excellent fruit. In these districts, sour cherries, pears, American and European plums and peaches are raised; while all the vegetables, grains and alfalfa are also grown. The famous Denia onion has been grown more extensively around Lakewood than in any other place in the state. Tomatoes of excellent quality are grown around Lakewood and Dayton, where there are two canning factories in operation. To the west, on the Peñasco River, apples, alfalfa, corn, barley, oats and wheat are raised. Some Irish potatoes have been suc-

cessfully grown in the silt bottom of this river, but not in the Pecos Valley.

This is an important grazing county. The mesas east of the Pecos River and west extending into the Sacramento and Guadalupe Mountains afford good grazing for sheep and cattle. The raising of hogs on alfalfa in the irrigated valleys, as well as the feeding of lambs and old ewes, is also becoming an important industry.

GRANT COUNTY

STATION—FORT BAYARD. APPROX. LAT.—32° 48′. LONG.—108° 10′. ELEVATION—6,152 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Precipitation	1867	*0.71	*1.25	0.67	0.20	T.	0.00	4.45	2.19	1.60	0.75	0.55	1.50	13.87	8.44	
	1868	1.35	0.50	*0.58	0.43	0.90	0.00	4.81	2.52	2.66	6.05	0.35	1.08	15.23	11.32	
	1869	0.60	0.44	0.53	0.19	0.00	3.74	0.87	4.17	0.03	0.76	0.57	0.94	12.84	9.00	
	1870	0.38	0.32	0.33	0.02	0.00	1.10	2.96	3.57	0.73	0.01	0.00	0.65	10.07	8.38	
	1871	0.64	0.05	0.10	0.10	0.00	0.05	0.09	0.19	2.27	0.75	1.30	0.25	5.79	2.70	
	1872	0.85	0.72	0.27	0.66	0.11	1.26	2.85	3.37	1.25	0.15	0.04	2.08	13.61	9.50	
	1873	0.48	1.91	0.87	0.04	0.29	1.10	3.02	1.73	1.30	0.00	0.70	0.74	12.18	7.48	
	1874	1.79	5.68	1.72	2.32	0.90	0.30	2.09	2.38	0.83	1.00	0.65	0.72	20.38	8.82	
	1875	0.75	1.55	0.80	0.02	T.	0.04	7.22	2.08	5.90	T.	0.00	1.30	19.66	15.26	
	1876	0.98	0.08	0.24	T.	0.40	2.44	2.88	3.16	3.24	4.17	1.13	0.22	18.94	12.12	
	1877	0.38	3.54	0.29	0.60	0.47	0.00	2.84	1.71	0.97	0.61	0.17	1.54	13.12	6.59	
	1878	0.03	0.71	1.05	.....	....	0.05	3.92	7.70	0.27	0.00	3.81	0.77	.....	11.94	
	1879	2.78	1.12	0.32	0.01	0.00	0.08	1.37	3.85	2.41	1.06	0.28	0.49	13.77	7.72	
	1880	0.79	0.85	0.53	0.30	0.00	0.99	3.05	3.51	3.57	1.56	0.00	1.65	16.90	11.42	
	1881	0.02	0.73	0.91	0.48	1.01	0.43	9.62	8.69	3.89	3.21	1.55	0.28	30.82	24.12	
	1882	1.83	2.06	1.17	0.08	1.37	1.92	1.84	6.00	1.05	0.00	1.37	0.58	19.27	12.26	
	1883	1.68	0.63	1.57	.....	....	....	4.69	7.67	1.06	....	.....	....	.....	13.42	
	1886	1.05	1.07	0.18	.....	0.02	1.16	1.16	1.90	2.93	1.60	.....	0.00	.....	7.17	
	1887	0.08	1.51	0.90	0.01	0.06	0.25	1.57	3.64	4.30	0.55	0.00	0.27	12.24	9.83	
	1888	0.15	0.29	0.90	*0.35	0.10	0.20	4.79	0.27	0.30	3.00	2.05	1.02	13.42	6.01	
	1889	0.59	0.41	0.18	T.	0.13	0.90	0.91	0.70	2.19	0.67	*0.62	T.	7.21	4.83	
	1890	1.40	T.	0.11	T.	0.00	T.	4.17	3.86	2.17	0.52	2.56	1.07	15.86	10.20	
	1891	0.87	1.03	0.36	0.00	1.55	0.35	1.00	1.82	1.49	0.07	0.06	1.70	10.30	6.21	
	1892	0.91	0.87	1.48	0.30	0.00	0.10	2.27	1.27	0.13	0.47	0.39	0.61	8.80	4.07	
	1893	0.85	0.14	0.35	0.00	1.50	T.	3.76	4.90	3.88	0.00	0.09	T.	15.47	14.04	
	1894	0.00	1.04	0.05	0.00	0.00	0.00	1.99	3.29	0.10	1.40	0.00	0.80	8.67	5.38	
	1895	1.25	0.80	0.08	0.00	0.80	0.33	6.25	2.09	0.85	0.40	1.40	0.20	14.45	10.32	
	1896	0.25	0.10	T.	T.	0.10	0.20	7.25	2.35	2.35	6.15	T.	0.10	18.85	12.25	
	1897	1.10	0.20	1.05	0.10	T.	0.60	3.38	5.31	4.11	1.90	0.00	0.25	18.00	13.50	
	1898	1.25	0.00	0.96	0.57	0.00	2.37	6.56	2.45	1.05	0.00	0.30	0.70	16.21	13.00	
	1899	0.30	0.20	0.30	0.23	T.	1.33	4.66	1.30	1.23	0.90	0.33	T.	10.78	8.75	
	1900	0.15	0.58	1.55	0.41	0.17	0.01	2.49	1.35	4.40	0.49	0.85	0.16	12.16	8.83	
	1901	0.41	0.65	0.60	0.25	T.	T.	2.10	0.90	1.00	2.57	0.46	T.	8.94	4.25	
	1902	0.15	0.35	0.04	0.00	0.31	0.53	0.91	7.13	2.16	0.26	0.83	3.00	15.67	11.04	
	1903	0.78	0.52	1.27	0.16	0.17	1.75	0.45	3.87	3.36	T.	0.00	T.	12.33	9.76	
	1904	0.16	0.09	0.32	0.00	0.26	0.18	1.76	4.42	2.81	8.18	0.31	2.13	20.62	9.43	

GRANT COUNTY, (Continued)

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
	1905	3.07	4.26	4.33	2.93	0.07	0.75	3.84	2.33	4.07	0.35	3.66	1.51	31.17	13.99	
	1906	0.41	1.63	0.85	0.79	0.08	T.	2.68	4.84	0.86	0.23	1.93	4.18	18 48	9.25	
	1907	3.35	0.30	0.15	0.80	1.07	0.88	1.34	4.15	1.69	1 12	0.87	0.00	15.72	9.93	
	1908	1.94	2.05	0.37	0.74	0.51	0.14	2.38	2.85	0.81	0.00	0.21	0.52	12.52	7.43	
	1909	0.33	0.86	1.05	0.00	0.00	0.94	2.05	3.65	1.55	0 03	0.07	0.90	11.43	8.19	
	1910	0.64	T.	T.	0.55	0.32	2.40	1.45	0.90	0.35	0.43	0.95	0.30	8.29	5.97	
	1911	1.55	1.29	1.70	0.40	T.	2.20	4.59	2.02	2.94	3 31	T.	0.63	20.63	12.15	
	1912	0.19	0.85	2.81	0.15	0.02	1.80	2.42	4.47	1.17	1.04	0.01	0.73	15 66	10.03	
	1913	0.72	2.37	0.27	0.23	0.47	0.51	2.20	3.28	1.18	0 34	2.95	1.15	15.67	7.87	
	1914	0.42	0.49	0.83	0.01	0.64	1.03	7.40	3.54	1.02	3.40	1.05	4.57	24 40	13.64	
	1915	1.74	2.49	1.91	1.40	T.	T.	3.88	3.62	3.08	0.09	0.16	2.00	20.37	11.98	
	1916	1.87	1.14	1.00	0.40	0.52	0	2.77	5.34	1.92	2.68	0.01	0.47	18.12	10.95	
	1917	2.45	0.12	0.02	0.59	0.31	0.06	1.24	1.19	1.85	0 21	0.00	0.00	8.04	5.24	
Mean		0.95	1.02	0.76	0.37	0.31	0.71	3.15	3.25	1.97	1.18	0.73	0.89	15.29	9.76	
Days with precip.		4	4	4	3	2	4	10	11	6	4	2	3	57	36	16
Av. snowfall, in.		1.7	3.1	2.7	T.	0	0	0	0	0	0 3	1.2	3.2	12.2		16
Prevailing wind		W	W	W	SW	SW	W	n SW	W	W	W	W	W	W		15
Temperature—																
Mean		38.5	40 6	46.3	53.2	61.7	71.1	72.7	71.2	66.5	56.7	46.4	39.1	55.4		38
Mean Max.		53.4	55.2	61.4	69.0	77.3	86.4	86.4	84.8	80.2	70.6	60.8	51.2	69.6		16
Mean Min.		26.4	27.7	33.0	38.8	45.0	53.6	58.2	57 1	52.0	40.7	32.2	25.4	40.8		16
Highest		72	80	85	87	93	103	100	98	100	85	78	72	103		16
Lowest		−12	5	9	19	25	37	46	48	34	19	−1	5	−12		16
Days clear		21	20	22	23	25	22	14	15	20	23	23	22	250	119	17
Days partly cl'dy.		7	5	6	5	4	6	13	13	8	6	5	5	83	49	17
Days cloudy		3	4	3	2	2	2	4	3	2	2	2	4	33	15	17

Frost—Average date of first killing frost in autumn, Oct. 21.
Average date of last killing frost in spring, April 23.
Earliest date of killing frost in autumn, Oct. 3.
Latest date of killing frost in spring, May 27.
Average length of growing season, 181 days.
Years recorded, 16.

*Computed from nearby stations.

GRANT COUNTY

STATION—LORDSBURG. APPROX. LATITUDE—32° 22'. LONGITUDE—108° 42'. ELEVATION—4,245 FEET.

	Year	Jan.	Feb.	Mar.	Apr.	May.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Precipitation	1881	.....	....	....	.....	....	....	....	....	....	.....	0.49	0.43	.....	.....	
	1882	0.95	0.35	0.38	0.00	0.59	0.63	1.32	3.12	0.00	0.00	1.20	0.20	8.74	5.66	
	1883	0.33	0.37	0.00	0.00	0.00	0.00	1.00	3.45	0.11	*0.56	*0.40	0.20	6.42	4.56	
	1884	0.80	0.13	1.20	0.20	T.	0.00	2.20	1.30	2.35	2.55	0.00	1.46	12.19	6.05	
	1885	0.00	0.20	0.40	T.	0.40	0.39	0.75	0.35	0.05	0.20	0.55	0.70	3.99	1.94	
	1886	0.00	0.33	0.00	0.00	0.00	0.00	1.54	1.65	1.17	0.17	0.20	0.00	5.06	4.36	
	1887	0.00	0.12	0.00	0.00	0.10	0.30	3.17	2.67	1.31	0.00	0.32	0.70	8.69	7.55	
	1888	0.44	0.10	0.88	0.00	0.00	0.28	2.97	0.84	0.76	2.14	1.50	0.92	10.83	4.85	
	1889	4.07	0.45	0.10	0.20	0.00	0.25	1.70	1.28	1.76	0.41	0.02	0.10	10.34	5.19	
	1890	0.92	0.05	0.00	0.13	0.00	1.43	3.11	3.69	1.90	0.26	0.60	1.86	13.95	10.26	
	1891	0.10	1.52	0.65	0.00	1.01	0.00	0.00	1.10	0.88	0.00	0.00	0.40	5.66	2.99	
	1892	0.50	1.01	0.92	0.71	0.00	0.00	0.05	0.20	0.05	0.69	0.00	0.00	4.13	1.01	
	1893	T.	0.90	1.00	0.00	1.96	T.	0.90	2.36	2.15	0.00	0.00	0.05	9.32	7.37	
	1894	0.70	0.66	0.20	0.00	0.00	0.00	0.89	4.30	0.10	0.90	0.00	T.	7.59	5.29	
	1895	0.20	0.00	T.	0.00	0.45	0.40	1.22	0.45	0.84	0.40	1.38	0.10	5.44	3.36	
	1896	T.	T.	0.48	0.00	0.26	0.30	1.91	2.34	1.51	6.46	0.20	0.15	13.55	6.26	
	1897	1.21	0.20	0.12	0.00	0.05	0.12	3.95	1.25	4.50	1.75	0.00	0.18	13.33	9.87	
	1898	1.00	0.00	0.75	0.16	0.00	0.33	2.30	0.17	0.16	0.00	0.60	0.66	6.13	3.12	
	1899	0.33	0.08	0.18	0.04	0.00	0.70	2.62	0.50	1.18	0.00	0.10	T.	5.73	5.04	
	1900	0.24	0.10	1.25	0.49	0.00	0.00	0.38	1.25	2.71	0.12	0.45	0.00	6.99	4.83	
	1901	0.40	0.50	0.20	*0.13	T.	0.00	2.30	0.93	0.00	*2.17	0.76	T.	7.41	3.38	
	1902	T.	0.10	T.	0.00	0.00	0.20	0.85	2.55	0.40	0.13	0.52	1.12	5.87	4.00	
	1903	0.00	T.	0.90	0.00	0.27	0.58	0.45	0.70	0.93	0.00	0.00	0.21	4.04	2.93	
	1904	0.14	0.16	0.23	0.00	0.04	0.38	1.09	1.12	3.09	0.69	0.55	1.21	8.07	5.72	
	1905	1.57	3.25	3.24	1.27	0.12	0.56	2.10	0.92	2.59	0.32	2.93	0.53	19.50	7.56	
	1906	0.15	1.07	0.07	0.07	T.	0.00	1.67	1.80	0.02	0.00	1.31	3.42	9.58	3.56	
	1907	2.52	0.51	0.00	0.27	0.60	T.	2.20	4.05	T.	1.20	0.80	0.00	12.15	7.12	
	1908	1.75	0.71	0.34	0.68	0.20	0.00	1.61	0.97	0.65	1.10	0.35	1.30	8.66	4.11	
	1909	T.	0.20	1.30	0.00	0.00	0.05	4.22	2.36	0.95	0.70	0.00	0.40	10.18	7.58	
	1910	0.48	0.00	0.00	0.02	0.42	0.60	2.09	0.87	T.	0.00	0.26	0.02	4.95	4.00	
	1911	0.64	0.95	0.26	0.83	0.00	1.31	2.46	0.50	0.58	1.60	0.00	2.60	11.73	5.68	
	1912	T.	1.15	2.14	0.07	0.06	0.51	4.19	2.14	0.00	1.07	0.18	2.64	14.15	6.97	
	1913	*1.00	2.43	0.51	0.35	T.	0.28	0.43	0.38	1.70	0.30	3.89	0.42	11.69	3.14	
	1914	0.88	0.62	0.45	0.00	1.17	0.93	2.63	4.06	1.00	2.81	0.69	4.46	19.70	9.79	

GRANT COUNTY, (Continued)

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
	1915	1.08	0.87	1.75	0.80	0.00	0.00	2.93	1.60	0.24	0.00	0.00	1.64	10.91	5.57	
	1916	3.85	0.25	0.39	0.10	0.00	0.00	1.00	....	....	.....	0.73	....	.....	.....	
	1917	1.25	0.50	0.00	0.46	1.24	0.26	0.96	0.92	2.69	0.00	0.00	0.00	8.28	6.53	
Mean		0.76	0.57	0.56	0.20	0.25	0.30	1.81	1.66	1.09	0.79	0.60	0.79	9.38	5.31	
Av. No. days with precipitation ...		2	3	3	2	1	2	6	5	3	2	2	3	34	19	13
Av. snowfall, in...		0.1	1.2	0.8	0.3	0	0	0	0	0	0	0.2	2.4	5.0		14
Temperature—																
Mean		42.9	46.2	53.5	60.8	68.7	78.6	82.3	80.1	74.3	61.4	50.4	42.6	61.8		13
Mean Max.		60.4	62.5	71.1	76.9	85.8	95.4	95.2	93.5	89.9	79.3	68.1	56.7	77.9		8
Mean Min.		29.0	31.6	37.5	42.0	47.1	57.2	64.4	63.6	57.4	43.4	32 0	26.4	44.3		8
Highest		79	79	93	93	100	105	108	104	99	94	84	78	108		8
Lowest		−9	8	21	23	27	43	50	51	36	23	9	3	−9		8
Prevailing wind..		E	E	W	W	W	W	W	E	E	E	E	E	E		13
Days clear		21	14	19	20	19	14	10	9	13	22	20	22	203	85	15
Days partly cl'dy.		5	9	6	6	10	11	12	15	11	5	5	4	99	65	15
Days cloudy		5	5	6	4	2	5	9	7	6	4	5	5	63	33	15

Frost—Average date of first killing frost in autumn, Oct. 31.
Average date of last killing frost in spring, March 26.
Earliest date of killing frost in autumn, Oct. 18.
Latest date of killing frost in spring, May 5.
Average length of growing season, 219 days.
Years recorded, 14.

*Computed from nearby stations.

This is a large southwestern border county, with a large area of comparatively low mesa land (4,000 to 5,000 feet) and vast mountain areas rising to 10,000 feet, in localities, over its northeast portions. The southern mesa districts are hot and dry, having an average annual precipitation of 9 to 10 inches and about 62 degrees annual mean temperature. Precipitation increases to 14, 16 and even 20 inches in the higher northern districts, and the temperature decreases to 58 degrees, 55 degrees, and probably as low as 50 degrees in the higher districts. The maximum of the summer in the lowlands will go well above 100 degrees each summer and toward zero each winter, while 90 to 100 degrees will be the highest of the summer in the foothills and mountains, and zero to 10 degrees below the minimum of the winter. Winds, throughout the district, are prevailing westerly and rather blustery in the spring, over the mesas, but lighter in the foothills and mountains.

Average annual precipitation, 10 to 14 inches, to 16 or 20 inches in the mountains.

Average seasonal precipitation, 5 to 10 or 12 inches.

Average seasonal snowfall, 5 to 12 inches, and to 50 inches in the mountains.

Mean annual temperature, 55 to 62 degrees.

Mean summer temperature, 72 to 80 degrees.

Mean winter temperature, 39 to 44 degrees.

Farming is done in the intermontane valleys where there is water for irrigation, and on the slopes of the mountains and hills where the rainfall is enough to insure successful growing of some crops under dry farming conditions. Outside of the early spring frosts the climatic and soil conditions are favorable for the growing of most of the temperate zone fruits, principally apples, pears, European and native plums, sour cherries and grapes. Alfalfa, beans, chile, melons, onions, cabbage, tomatoes, beets, turnips, corn and saccharine sorghums are the principal crops grown under irrigation along the Mimbres and Gila Valleys, which are the largest irrigated districts. Under dry farming, in the higher altitudes, where the rainfall is usually a little heavier, fairly good results may be expected from corn of the short season varieties, wheat, oats. barley, beans, pumpkins, squash and melons. Irish potatoes are

grown in the Upper Mimbres and Gila Valleys, and are more of a success in these higher mountain districts, where they are able to get sufficient moisture from rainfall or from irrigation, than in other localities. In the southwestern part of the county very little farming is done, on account of the lack of sufficient moisture, although the soil is capable of growing many crops, if water could be had for irrigation.

Conditions are exceptionally good for stock raising, more cattle being grazed in this county than in any other in the state. The growing of Angora goats in the mountain sections has been taken up to a considerable extent.

GUADALUPE COUNTY

STATION—SANTA ROSA. APPROX. LATITUDE—34° 55′. LONGITUDE—104° 40′, ELEVATION—4,624 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs
Precipitation	1884	.....	.....	.....	T.	1.20	1.07	2.10	5.63	1.29	1.04	*0.14	0.26	......	11.29	
	1885	0.92	3.18	0.74	0.26	2.40	3.18	0.65	2.81	1.43	0.33	0.14	0.66	16.70	10.73	
	1886	1.04	0.71	0.81	0.39	0.00	1.09	1.00	5.56	3.85	....	.....	.....	......	11.89	
	1895	*0.52	*1.01	*0.06	T.	3.41	0.24	4.87	4.67	0.10	0.67	0.83	0.35	*16.73	13.29	
	1896	0.15	0.05	0.10	0.15	T.	2.00	2.13	2.42	2.00	3.40	0.10	2.05	14.55	8.70	
	1897	1.70	0.20	0.80	0.35	2.05	2.02	1.62	3.09	0.63	0.80	0.10	*0.50	*13.86	9.76	
	1898	0.10	0.00	0.30	0.78	T.	2.04	5.41	*0.99	1.56	0.10	0.75	1.95	*13.98	10.78	
	1899	T.	0.40	1.00	0.22	0.00	2.27	....	.....	....	....	.....	.....	......	.....	
	1908	0.09	0.54	T.	1.49	0.10	1.02	4.27	3.51	0.43	0.48	0.93	0.13	12.99	10.82	
	1909	0.15	0.11	1.43	0.07	0.38	0.15	3.90	2.48	0.60	1.04	0.22	0.24	10.77	7.58	
	1910	0.63	T.	0.27	0.56	0.08	1.10	0.63	3.14	1.33	0.68	0.46	0.03	8.91	6.84	
	1911	0.27	1.88	0.17	2.06	0.42	0.29	2.96	2.08	1.41	1.50	0.41	0.62	14.07	9.22	
	1912	T.	1.47	0.36	0.47	0.94	2.65	2.38	1.04	0.81	0.27	0.00	0.20	10.59	8.29	
	1913	0.37	0.25	0.14	1.32	0.88	2.68	0.32	0.66	1.47	0.32	1.03	1.55	10.99	7.33	
	1914	0.00	0.28	0.12	1.10	6.09	2.00	4.53	2.99	0.50	2.93	0.00	1.07	21.61	17.21	
	1915	1.02	0.63	1.30	3.32	0.99	0.30	3.82	1.30	1.26	0.72	0.08	0.42	15.16	10.99	
	1916	0.68	0.00	0.23	2.02	0.16	0.21	1.41	2.90	0.34	1.87	0.08	0.04	9.94	7.04	
Mean		0.48	0.67	0.49	0.86	1.12	1.43	2.62	2.83	1.16	1.08	0.35	0.67	13.76	10.02	
Av. No. days with precipitation ..		2	3	4	4	6	6	10	9	6	4	2	3	59	41	8
Av. snowfall, in...		1.8	5.1	4.1	T.	0	0	0	0	T.	0.6	2.0	3.9	17.5		8
Temperature—																
Mean		39.2	40.7	47.8	55.5	63.6	73.6	76.8	75.0	67.6	56.6	47.2	36.9	56.7		8
Mean Max.		53.7	56.6	64.0	71.6	80.2	90.6	92.5	89.8	83.8	73.3	63.9	51.0	72.6		8
Mean Min.		24.7	24.8	31.5	39.4	47.0	56.6	61.2	60.2	51.5	40.0	30.6	22.8	40.9		8
Highest		76	74	85	93	98	104	107	102	96	92	84	74	107		8
Lowest		–10	0	2	21	23	42	51	47	32	20	2	–12	–12		8
Prevailing wind..		W	W	W	W	W	S	S	S	W	W	W	W	W		8
Days clear		22	16	20	15	17	15	12	14	19	21	24	20	215	92	8
Days partly cl'dy..		6	7	6	10	10	11	15	13	9	6	4	7	104	68	8
Days cloudy		3	5	5	5	4	4	4	4	2	4	2	4	46	23	8

GUADALUPE COUNTY, (Continued)

Frost—Average date of first killing frost in autumn, Oct. 23.
Average date of last killing frost in spring, April 12.
Earliest date of killing frost in autumn, Oct. 14.
Latest date of killing frost in spring, May 2.
Average length of growing season, 194 days.
Years reported, 11.

*Computed from nearby stations.

This is an east central county, traversed from northwest to southeast by the upper Pecos within a fairly deep channel. Altitudes within the county run from about 4,000 feet to well above 6,000 feet along its northwest border, and there is much broken, upland grazing country within the county. The precipitation averages about 14 inches in the lower levels and increases slightly over the mesas and plateaus; mean temperature about 57 degrees, with maximum close to 100 degrees each summer, and minimum to zero and occasionally 5 to 10 degrees below. The winds are fresh and prevailing westerly, with much clear, dry weather.

Average annual precipitation, 13.5 to 15 inches.

Average seasonal precipitation, 10 to 12.5 inches.

Average seasonal snowfall, 15 to 20 inches.

Mean annual temperature, 54 to 57 degrees.

Mean summer temperature, 72 to 75 degrees.

Mean winter temperature, 36 to 39 degrees.

All along the Pecos River farming is done under irrigation. Wherever water can be put on the land good crops of alfalfa, peas, corn, the sorghums, wheat, barley, oats, onions, beans, chile, cabbage, tomatoes and squash are successfully raised. Among the fruits the apple is the principal one, although good pears, sour cherries, American and European plums, as well as peaches, are also raised. Under dry farming the most dependable crops are the feed and grain sorghums and the New Mexico Pinto bean. On a smaller scale broom corn, cowpeas, pumpkins, watermelons and Indian corn are raised. The results from the dry farming crops depend upon the amount of rainfall during the growing season. Irish potatoes have not proven a success. Most of the dry farming is done in the east and northeast portions of the county, as well as in the higher western parts.

For many years this has been an important stock raising county. The southern and southwestern mesas are used mostly for grazing sheep, while the northern and northeastern parts of the county are used for cattle.

LEA COUNTY

STATION—KNOWLES. APPROX. LATITUDE—32° 52′. LONGITUDE—103° 09′. ELEVATION—4,300 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs
Precipitation	1910	....	....	....	....	....	....	0.45	3.71	0.51	0.45	0.25	T.	.....		
	1911	0.48	1.88	0.46	1.05	0.68	0.94	4.22	0.53	2.06	0.51	0.17	1.16	14.14	9.48	
	1912	0.01	0.50	0.47	0.35	0 20	1.59	1.12	1.29	1.98	0.97	0.03	0.49	9.00	6.53	
	1913	0.03	0.26	0.77	1.10	0.05	2.05	1.28	0.52	6.22	2.58	1.56	1.22	17.64	11.22	
	1914	T.	0.22	0.20	0 88	2.31	3.10	3.87	1.89	1.84	6.73	1.02	1.63	23.69	13.89	
	1915	0.30	1.60	2.62	3.48	0.45	2.16	1.58	2.00	7.02	0.12	0.03	0.84	22.20	16.69	
	1916	0.16	T.	....	....	....	....	....	....	....	....	....	....	.....	.....	
	1917	0.13	T.	0.10	T.	0.53	0.07	0.43	1.11	2.67	T.	0.11	0.00	5.15	4.81	
Mean		0.31	0.44	0.46	0 92	0.99	1.36	2.84	1.67	2.40	2.16	0.76	0.64	14.95	10.18	
Av. No. days with precipitation ..		1	2	5	6	4	8	6	7	6	4	3	4	56	37	
Snowfall, in.		1.1	0.9	1.3	T.	0	0	0	0	0	T.	1.8	2.4	7.5		9
Temperature—																
Mean		42.2	42.6	48.3	58.4	67.8	74.6	78.0	77.2	70.7	59.3	49 5	39.4	59.		5
Mean Max.		59.3	58.6	64.3	74.4	83.1	88.9	92.3	91.3	85.7	74.3	65.6	52.7	74.2		5
Mean Min.		25.1	26.7	32.3	42.3	52.4	60.2	63.7	63.1	55.7	44.4	33 4	26.1	43.8		5
Highest		81	84	87	94	100	104	104	104	99	92	83	75	104		5
Lowest		–10	3	1	25	24	42	54	52	35	20	6	4	–10		5
Prevailing wind..		SW	SW	SW	SW	SE	SE	SE	SE	SE	SW	SW	SW	SW		5
Days clear		22	15	18	18	18	16	17	18	19	22	21	18	22	106	
Days partly cl'dy.		5	8	6	8	10	11	12	12	9	5	5	6	96	61	
Days cloudy		4	5	7	4	3	3	2	1	3	4	4	7	47	16	

Frost—Average date of first killing frost in autumn, Oct. 27.
Average date of last killing frost in spring, March 30.
Earliest date of killing frost in autumn, Oct. 15.
Latest date of killing frost in spring, May 7.
Average length of growing season, 211 days.

This is the newly created southeast border county, a rolling prairie district, in what was long known as the "staked plains." The county averages about 4,000 feet in altitude, with an annual precipitation of about 15 inches, 10 to 12 inches of which occurs during the crop growing season from April to September. It is an open, rather dry, sunshiny district, with an average annual temperature of about 60 degrees. The maximum will go well above 100 degrees each summer and to zero or somewhat below each winter during one or two brief storms.

Average annual precipitation, 14 to 16 inches.
Average seasonal precipitation, 10.5 to 13 inches.
Average annual snowfall, 7 to 12 inches.
Mean annual temperature, 59 to 61 degrees.
Mean summer temperature, 77 to 80 degrees.
Mean winter temperature, 41 to 42 degrees.

In this county all of the agriculture is carried on under dry farming methods, as there are no streams or artesian wells. The principal crops are the grain sorghums, such as milo, kafir and feterita, and a number of the feed sorghums. Corn and cotton are also raised. The New Mexico Pinto bean is being introduced; and the results have been satisfactory. Since there is no irrigation in this county and the rainfall is the limiting factor in farming operations, the number of varieties of agricultural plants is somewhat limited. Naturally the grain and feed sorghums, as well as corn, beans and cotton, will be the principal paying crops. Many home gardens and orchards, of a half acre or so, are raised by windmill irrigation; and garden peas, beans, melons, pumpkins, sweet potatoes, tomatoes, cabbage, cherries, peaches and grapes are grown. Some comparatively shallow water belts are found, from 35 to 50 feet, which may develop into pumping projects; provided, of course, that cheap power and efficient machinery may be obtained.

Because of the open condition of the country it is subject to an occasional norther in winter; but nevertheless it is a most promising cattle and stock raising, as well as stock farming, county.

LINCOLN COUNTY

STATION—CORONA. APPROX. LATITUDE—34° 16′. LONGITUDE—105° 38′. ELEVATION—6,666 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Precipitation	1909	....	....	....	....	....	....	2.93	3.35	1.63	1.29	0.25	1.08	.....	.....	
	1910	0.53	1.62	0.35	T.	0.12	0.61	1.40	2.59	0.50	0.65	....	0.05	8.92	5 22	
	1911	0.21	1.63	0.99	1.98	0.48	1.48	4.04	0.60	1 00	0.83	0.39	1.08	14.71	9.58	
	1912	0.08	1.52	0	0.44	0.43	2.36	1.97	2.55	0.72	0.55	0.04	0.70	11.36	8.47	
	1913	1.80	0.46	0.61	0.54	0	2.20	0.40	1.52	2.14	0.09	0.55	1.30	11.61	6.80	
	1914	0.15	0.28	0.11	1.30	1.21	2.41	5.28	5.56	T.	2.23	0	0.82	19.35	15.76	
	1915	0.81	0.89	1.69	2.00	0.94	0.66	4.35	3.35	1 55	0.35	0	1.07	17.66	12.85	
	1916	0.67	T.	0.62	1.67	0.40	T.	1.50	2.20	T.	2.70	0.42	0.22	10.42	5.77	
	1917	0.60	0.83	0.30	0.20	0.92	0.45	0.10	2.52	0 55	0.00	0.11	0.00	6.58	4.74	
Average		0.61	0.90	0.59	1.01	0.46	1.27	2.44	2.69	0.90	0.97	0.22	0.70	12.58	8 77	
Av. No. days with precipitation ..		3	3	4	4	2	5	6	7	3	3	1	5	46	27	8
Snowfall, in......		7.8	14.1	5.8	3.0	0.3	0	0	0	1.3	1.2	2.2	9.9	45.6		8
Temperature—																
Mean		28.7	38.4	43.8	51.0	59.9	68.2	70.0	68.8	64.0	53.4	39.0	33.4	51.6		
Mean Max.		34.7	50.5	55.6	63.0	73.4	81.1	81.5	80.8	76.8	67.0	46.8	44.1	62.9		
Mean Min.		22.7	26.2	31.9	39.0	46.4	55.4	58.4	56.7	51.3	39.9	31.3	22.7	40.2		
Highest		64	64	76	78	86	92	105	95	88	83	76	66	105		
Lowest		–12	6	0	14	23	38	44	42	30	18	0	–12	–12		
Prevailing wind..		W	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	W	SW		
Days clear		16	13	16	14	16	11	3	7	15	16	21	16	164	66	
Days partly cl'dy..		10	10	9	11	12	15	19	20	11	11	6	9	143	88	
Days cloudy		5	5	6	5	3	4	9	4	4	4	3	6	58	29	

LINCOLN COUNTY

STATION—FORT STANTON. APPROX. LATITUDE—33° 30′. LONGITUDE—105° 32′. ELEVATION—6,231 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Precipitation	1856	0.50	0.58	1.59	0.24	0.26	0.68	1.99	3.62	2.81	0.19	2.14	2.21	16.81	9.60	
	1857	0.67	0.97	0.17	0.62	0.69	1.27	4.88	9.24	6.14	2.59	0.87	0.59	28.70	22.84	
	1858	0.65	0.12	1.47	0.31	0.70	2.00	3.49	8 09	0.74	0.47	0.24	0.48	18.76	15.33	
	1859	0.09	0.53	1.00	0.30	0.20	3.19	3.30	6.93	3.77	2.60	0.25	1.65	23.81	17.69	
	1860	0.39	3.55	0.08	1.41	*T.	1.03	1.50	2.87	0.78	0.08	0.75	1.21	13.65	7.59	
	1861	1.76	0.50	.....	T.	3.14	3.38	4.23	....	.....	.....	.....	.....	.....	.....	
	1864	.....	.....	.....	....	.....	.....	.....	....	1.14	.....	.....	.....	.....	.....	
	1866	.....	.....	.....	....	.....	.....	.....	....	1.15	.....	.....	.....	.....	.....	
	1867	.....	.....	.....	....	.....	.....	.....	1.50	0.50	.....	.....	.....	.....	.....	
	1868	.....	.....	.....	....	.....	.....	.....	....	1.02	.....	0.39	0.62	.....	.....	
	1869	0.49	1.36	1.18	2.75	4.17	3.70	1.44	2.45	*0.05	0.88	0.42	3.92	22.81	14.56	
	1870	0.00	0.00	2.20	0.22	0.18	2.08	4.45	4.70	0.94	2.84	0.00	0.36	17.97	12.57	
	1871	1.68	0.07	4.28	0.00	0.65	0.14	5.80	1.13	2.10	*1.50	*0.15	3.00	20.50	9.82	
	1872	0.66	0.63	0.37	0.66	0.00	2.29	4.78	3.19	3.27	3.02	3.54	*2.34	23.75	14.19	
	1881	.....	.....	.....	....	.....	.....	.....	1.05	2.65	2.59	0.66	0.35	.....	.....	
	1882	0.95	0.30	0.26	0.22	T.	0.50	0.56	1.87	0.70	0.00	1.21	0.21	6.78	3.85	
	1883	0.00	0.00	.....	0.00	T.	0.10	0.95	4.10	.....	.....	.....	.....	.....	.....	
	1884	1.20	0.40	0.70	0.30	1.73	2.11	2.48	6.98	3.21	2.65	0.30	1.44	23.50	16.81	
	1885	0.72	0.63	0.62	0.50	0.62	1.35	3.17	2 57	1.36	0.18	0.50	0.35	12.57	9.57	
	1886	0.36	0.17	0.50	1.50	*0.10	1.61	4.71	5.45	4.29	1.32	0.15	0.08	20.24	17.57	
	1887	0 01	0.11	0.25	0.04	0.72	2.50	2.59	3.49	4.21	1.75	0.17	0.93	16.77	13.55	
	1888	0.22	1.09	2.82	1.69	0.25	0.88	1.60	4.51	1.16	2.14	1.53	0.15	18.04	10.09	
	1889	1.33	0.39	0.86	0.24	0.17	2.51	2.36	0 89	2.76	1.90	1.04	0.04	14.49	8.93	
	1890	0.37	0.08	0.12	0.57	0.00	1.05	1.92	2.93	1.52	0.40	1.85	1.06	11.87	7.99	
	1891	1.00	1.66	0.98	0.02	2.83	2.37	1.30	1.65	1.33	0.12	0.19	1.23	14.68	9.50	
	1892	0.56	0.36	1.15	0.27	0.11	0.45	2.87	1.41	0.32	1.76	0.65	1.43	11.34	5.43	
	1893	0.75	1.60	0.11	0.00	0.72	0.45	3.57	4 74	3.47	0.04	*0.20	0.15	15.80	12.95	
	1894	0.00	0.61	0.27	0.96	1.02	1.07	1.35	4.88	0.15	1.46	T.	0.37	12.14	9.43	
	1895	0.47	1.02	0.11	T.	1.06	1.45	6.03	1.61	0.65	0.78	1.24	*0.05	14.47	10.80	
	1900	*1.00	*0.25	0.48	0.90	1.09	1.63	1.98	2.18	6.06	1.43	0.40	0.36	17.76	13.84	
	1901	0.10	*2.00	*0.50	0.90	0.64	1.34	*3.25	1 85	2.00	1.76	2.85	0.92	18.14	11.74	
	1902	0.05	0.38	0.22	0.00	1.88	0.24	2.28	1.87	0.48	1.81	0.16	0.57	9.94	6.75	
	1903	0.36	0.75	0.17	0.20	0.38	3.41	0.62	1.55	1.55	0.48	0.00	0.05	9.52	7.71	
	1904	0.02	0.10	0.03	0.15	0.14	*1.50	2.87	2.92	6.06	2.68	0.08	0.35	16.90	13.64	
	1965	0.40	1.32	*1.75	2.04	T.	2.79	5.62	2.12	T.	*0.50	*4.25	1.80	22.59	12.57	
	1906	0.35	0.35	T.	1.40	0.02	0.25	4.38	4.34	1.95	1.45	0.86	1.68	17.03	12.34	

LINCOLN COUNTY, (Continued)

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
	1907	0.25	0.52	T.	0.15	0.20	3.35	2.74	4.58	1.85	2.64	0.99	0.02	17.29	12.87	
	1908	0.15	0.60	0.15	1.15	0.48	0.19	2.49	6.46	1.32	0.05	0.75	T.	13.79	12.09	
	1909	0.18	0.20	2.02	0.00	0.20	0.67	3.28	3.54	0.59	0.82	T.	0.25	11.75	8.28	
	1910	0.10	0.37	0.35	0.44	0.18	2.85	1.57	4.57	0.90	0.56	0.77	0.23	12.89	10.51	
	1911	0.15	1.82	0.80	1.99	0.75	3.11	5.62	1.83	1.50	2.28	0.16	0.47	20.48	14.80	
	1912	T.	0.53	0.34	0.69	0.57	5.04	2.63	4.90	2.24	1.18	0.25	0.12	18.49	16.07	
	1913	1.04	0.34	0.71	1.13	0.08	2.81	2.07	1.37	3.57	0.70	0.88	1.50	16.20	11.03	
	1914	0.21	0.28	0.20	0.90	1.12	1.85	4.84	2.29	0.80	2.62	0.14	1.35	16.60	11.80	
	1915	0.60	1.33	1.40	3.93	0.87	0.20	5.30	1.65	3.05	6.50	T.	1.21	20.04	15.00	
	1916	1.81	0.21	0.75	1.60	T.	0.08	2.65	4.16	1.78	1.35	0.32	0.19	14.90	10.27	
	1917	0.49	0.56	0.31	0.08	0.74	0.48	1.59	4.38	0.81	0.00	0.35	0.00	9.79	8.08	
Mean		0.53	0.68	0.78	0.73	0.68	1.67	3.03	3.45	2.02	1.32	0.77	0.84	16.50	11.58	
Av. No. days with precipitation ..		4	5	5	3	4	7	12	12	8	3	4	4	71	46	
Av. snowfall, in..		2.6	3.2	4.7	0.1	T.	0	0	0	0	0.5	3.0	4.9	19.0		20
Temperature—																
Mean		35.4	38.6	44.0	51.3	59.1	67.2	69.2	67.2	61.4	51.9	41.8	36.2	51.9		32
Mean Max.		49.4	52.1	57.8	66.2	73.2	82.9	82.7	80.7	76.5	67.3	57.1	50.2	66.3		19
Mean Min.		22.0	24.8	28.6	34.6	42.0	49.2	57.9	53.5	46.3	35.6	26.8	21.7	37.9		19
Highest		75	76	78	86	94	105	97	94	89	86	77	72	105		20
Lowest		−6	−9	−3	12	22	28	40	38	27	13	0	−18	−18		20
Prevailing wind..		W	W	W	W	W	W	W	W	W	W	W	W	W		20
Av. velocity ...		8	9	9	9	8	6	5	5	4	5	6	7	7		
Days clear		19	17	18	20	20	18	13	14	16	21	20	17	213	101	
Days partly cl'dy.		8	7	8	7	9	9	12	11	10	6	6	9	102	58	
Days cloudy		4	5	5	3	2	3	6	6	4	4	4	5	51	24	
Relative humidity		58	54	45	34	33	39	55	58	59	54	59	61	51		

Frost—Average date of first killing frost in autumn, Oct. 5.
Average date of last killing frost in spring, May 8.
Earliest date of killing frost in autumn, Sept. 17.
Latest date of killing frost in spring, June 2.
Average length of growing season, 150 days.

*Computed from nearby stations.

This is a south central upland county, largely mesas, foothills and mountains, with altitudes ranging from 4,500 to 10,000 feet. Large areas within the county are from 6,000 to 8,000 feet, but the altitude decreases along its eastern border to the rolling prairie. The lower levels are dry, averaging 10 to 14 inches annual precipitation, but the precipitation increases with altitude to about 16 inches at 7,000 feet and to 18 or 20 inches above 8,000 feet. The mean temperature averages from 51 to 55 degrees, with maximum up to 100 degrees in the lower levels and to 90 degrees in the foothills, while zero temperature to 10 or 12 degrees below occurs almost every winter for one or two brief periods.

Average annual precipitation, 10 to 14 inches, to 16 or 20 inches in mountains.

Annual seasonal precipitation, 8 to 12 inches, to 14 or 16 inches in mountains.

Average seasonal snowfall, 20 to 50 inches.

Mean annual temperature, 51 to 55 degrees.

Mean summer temperature, 69 to 75 degrees.

Mean winter temperature, 34 to 36 degrees.

Prevailing wind direction, westerly.

Average hourly velocity (at Fort Stanton), 7 miles.

Average relative humidity, 51 per cent.

Some agriculture is carried on under irrigation and dry farming. Most of the irrigation farming is done in the intermontane irrigated valleys, particularly on the Hondo, Ruidoso and Bonito Rivers. In these valleys alfalfa, beans, peas, wheat, oats, barley, and corn, as well as cabbage, chile, onions, tomatoes, beets, celery, and carrots, are among the principal crops raised. Considerable fruit is also grown in these valleys, principally apples. The Delicious, Jonathan, King David, White Winter Pearmain, Rome Beauty and Winesap are among the leading commercial varieties. Pears, sour cherries, European and native plums, as well as peaches, are grown on a smaller scale. Up in the higher altitudes of over 7,000 feet on the mountain slopes where the rainfall is greater, Irish potatoes and oats are raised. Some of the other dry farming

crops on the higher mesas are beans, both New Mexico Pinto and California Pink, peas and turnips, oats, wheat, short season corn, and barley.

This is an important cattle and sheep raising county; and goat raising is also becoming an important industry. Aside from cattle raising under range conditions, stock farming offers many possibilities.

LUNA COUNTY

STATION—DEMING. APPROX. LATITUDE—32° 16′. LONGITUDE—107° 45′. ELEVATION—4,333 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs
Precipitation	1869	*0.57	*0.94	1.38	0.90	1.10	3.52	1 07	4.94	0.08	0.44	0.52	0.65	16.11	11.61	
	1870	T.	0.06	0.26	T.	0.00	1.99	6.50	8.99	0.44	0.12	0.00	2.00	20.36	17.92	
	1871	0 68	0.15	0.05	0.00	0.00	1.40	2.84	1.83	2.88	0.72	0.14	0.10	10.79	8.95	
	1872	0.22	0.00	0.00	0.20	0.11	0.44	3.58	3.58	0.31	0.13	0.00	4.95	13.52	8.22	
	1873	2.00	0.62	0.32	0.15	0.05	1.27	1.27	....	....	.....	.....	.....	.....	.....	
	1881	......	.....	.....	....	....	....	....	....	....	.....	1.75	*0.65	.....	.....	
	1882	*0.75	*1.00	*0.50	0.00	0.00	0.43	1.22	2.55	0.52	0.00	1.54	0.20	8.71	4.72	
	1883	0.10	0.00	1.77	0.00	0.00	0.10	2.95	1.41	0.53	*1.32	0.30	*0.88	9.36	4.99	
	1884	0.80	0.70	0.20	0.20	0.00	0.00	0.52	1 04	0.80	1.53	*0.54	1.35	7.68	2.56	
	1885	0.00	*0.75	0.52	0.00	0.77	1.33	1.38	0.81	0.09	0.28	0.50	0.91	7.34	4.38	
	1886	0 68	0.50	0.00	0.00	0.00	0.00	1.13	4.19	4.36	0.50	0.00	0.00	11.36	9.68	
	1887	0.00	0.20	0.00	0.00	0.00	0.00	2.02	3.46	3.39	2.13	0.31	0.05	11.56	8.87	
	1888	0.26	1.77	0.24	0.50	0.70	0.50	1.08	0.60	0.00	1.60	1.45	0.27	8.97	3.38	
	1889	1.09	0.10	0.12	0.05	0.00	0.90	1.09	0.64	3.55	0.84	0.80	0.00	9.18	6.23	
	1890	0.53	0.00	0.00	0.13	0.00	0.16	4 09	2.20	2.26	0.47	0.42	*1.25	11.51	8.84	
	1891	0.40	0.53	0.64	0.00	0.48	0.14	0.18	1.20	0.80	0.00	0.00	0.18	4.55	2.80	
	1892	0.45	0 86	1.34	0.10	0.00	0.90	0.20	0.39	0.08	1.29	1.80	0.62	8.03	1.67	
	1893	0.19	0.50	0.42	0.00	1.45	0.01	2.82	3.19	2.64	0.00	0.00	0.10	11.32	10.11	
	1894	0.05	0.66	0.45	0.00	0.00	0.00	0 65	0.95	0.00	0.45	0.00	0.36	3.57	1.60	
	1895	0.50	0.15	0.00	T.	0.58	0.25	3.76	0.35	1.47	0 15	0.87	0.15	8.23	6.41	
	1896	0.60	T.	0.00	0.20	T.	0.15	4.30	1.95	2.00	3.25	0.25	0.00	12.70	8.60	
	1897	1.55	0.00	0.42	0.00	0.00	0.50	2.89	1.41	1.87	1 57	0.00	T.	10.21	6.67	
	1898	*0.75	T.	1.42	0.30	0.00	T.	1.66	2.38	0.21	0.00	0.10	0.60	7.42	4.55	
	1899	0.05	T.	T.	0.00	0.00	T.	3.92	0.78	0.54	T.	0.45	T.	5.74	5.24	
	1900	0.56	0.46	0.74	0.00	0.10	T.	2.10	0.08	3.10	0.20	0.04	0.03	7.41	5.38	
	1901	0.40	1.87	0.11	T.	T.	T.	0.98	0.90	0.05	0 75	0.31	T.	5.37	1.93	
	1902	T.	T.	T.	0.00	0.20	0.00	0.91	1.61	0.35	0.01	0.27	1.30	4 66	3.08	
	1903	0.49	0.85	1.00	0.00	0.13	3.32	0.01	0.40	2.84	0.00	0.00	0.05	9.09	6.70	
	1904	0.00	0.00	0.00	0.00	0.00	0.60	1 57	1.58	4.16	2.80	0.64	1.18	12.53	7.91	
	1905	1.53	2.08	2.15	1.87	0.00	1.05	0.90	1.25	2.74	0.32	2.72	0.98	17.59	7.81	
	1906	0.66	0.63	0.56	0.10	0.05	0.00	1.98	2.98	0.64	0.02	1.34	1.83	10.79	5.75	
	1907	1.42	0.08	0.06	0.19	0.39	0.35	3.18	1.95	2.40	0.41	1 26	0.00	11.69	8.40	
	1908	0.64	0.31	0.18	0.94	0.03	0.08	1.18	1.01	0.00	0.00	T.	0 13	4.50	3.24	
	1909	T.	1.03	0.51	0.00	0.00	0.02	0.40	1.58	0.88	0.89	0 00	0.70	6.01	2.88	
	1910	0.00	0.00	0.19	0.02	0.00	0.43	0.96	1.02	0.80	0.00	0.00	0 00	3.42	3.23	
	1911	0.77	1.40	0.67	0.38	0	0.96	7.13	0.30	1.77	1.30	0	0.42	15.10	10.54	

LUNA COUNTY (Continued)

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
	1912	0	0.48	0.89	0.68	0	0.88	2.00	4.04	0	1.76	0	0 40	11.13	7.60	
	1913	0.20	1.20	0.20	0.60	0	0.28	3.95	1.46	0.77	0.30	1.50	0.98	11.44	7.06	
	1914	0.40	0.25	0.25	0	1.40	2.84	5.86	2.30	0.65	0.40	0.30	2.90	17.55	13.05	
	1915	0.83	0.97	2.06	0.11	0	0	2.73	2.65	2.47	1.45	0	1.08	11.88	7.96	
	1916	0.51	0.49	0.52	0.20	1.50	0	2.38	5.40	0.60	3.50	0	0.18	15.28	10.08	
	1917	0.47	0.13	0.00	0 00	0.50	0.00	0.40	1.10	0.80	0.00	0.00	0.00	3.40	2.80	
Mean		0.52	0.51	0.53	0.19	0.26	0.60	2.19	2.01	1.32	0.74	0.49	0.67	10.03	6.57	
Av. No. days with precipitation ..		2	2	2	1	1	2	7	6	4	2	2	2	33	21	24
Av. snowfall, in..		0.9	1.2	0.8	T.	0	0	0	0	0	0	0.2	1.3	4.4		22
Temperature—																
Mean		42.5	44.8	51.8	56.8	65.1	75.2	78.0	76.6	71.6	60.2	49.2	41.6	59.5		
Mean Max.		58.9	60.4	69.1	74.6	84.6	94.8	94.3	92.1	88.5	79.2	66.9	58.4	76.8		11
Mean Min.		25.1	28.4	34.1	38.9	45.7	55.9	61.8	61.4	55.6	41.4	31.7	24.8	42.1		11
Highest		80	81	90	98	100	106	110	109	104	95	89	82	110		11
Lowest		–7	10	12	24	32	38	48	50	38	18	6	0	–7		11
Prevailing wind..		W	W	W	W	W	W	W	W	W	W	W	W	W		16
Days clear		20	16	20	20	22	21	13	15	19	22	22	22	232	110	24
Days partly cl'dy.		5	6	7	6	6	5	10	9	6	4	4	4	72	42	24
Days cloudy		6	6	4	4	3	4	8	7	5	5	4	5	61	31	24

Frost—Average date of first killing frost in autumn, Oct. 29.
Average date of last killing frost in spring, March 24.
Earliest date of killing frost in autumn, Oct. 4.
Latest date of killing frost in spring, April 23.
Average length of growing season, 217 days.

*Computed from nearby stations.

This is a southern border county, comparatively low in altitude (3,800 to 5,000 feet). The average annual precipitation is about 10 inches; mean temperature 60 degrees, with maximum well above 100 degrees each summer and occasionally touching zero in the winter. Much clear weather occurs, with prevailing westerly winds. Successful culture is possible only with irrigation.

Average annual precipitation, 9 to 10 inches.

Average seasonal precipitation, 6 to 7 inches.

Average seasonal snowfall, 5 inches, to 10 inches in mountains.

Mean annual temperature, 58 to 62 degrees.

Mean summer temperature, 77 to 80 degrees.

Mean winter temperature, 40 to 44 degrees.

The soil and climatic conditions in many localities are favorable for the growing of a number of the temperate zone fruits, but as yet there are no large commercial plantations. Wheat, barley, oats, rye, corn, the feed and grain sorghums, alfalfa, field peas, beans, tomatoes, melons, onions, garden peas, chile, cantaloupes, sweet potatoes, cabbage, table beets, carrots, spinach, and turnips can be grown successfully under irrigation, although beans, alfalfa and milo are the principal cash crops. The Irish potato is not very dependable, though occasionally a farmer here and there may produce a fair crop. Wherever water for irrigation can be had, because of the mild winter climate, early spinach, lettuce, cabbage, asparagus, onions, beets, garden peas and many of the other cool season crops can be produced for the early market.

Nearly all of the irrigation agriculture is being carried on by pumping from wells in the comparatively shallow water belts of the Lower Mimbres Valley. There is an abundance of underground water, which is awaiting the proper installation of pumps and cheap power for irrigation purposes.

The rainfall is not sufficient to insure success in the growing of crops under dry farming conditions.

A large part of the mesas and highlands are being used for grazing cattle and sheep. These are flourishing industries.

McKINLEY COUNTY

STATION—FORT WINGATE. APPROX. LAT.—35° 29′. LONGITUDE—108° 32′. ELEVATION—6,997 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Precipitation	1864	.....	.....	.....	.....	.....	.....	....	.....	1.10	....	.....	0.34	......	.....	
	1865	0.20	1.25	.....	0.16	0	0.09	1.89	2.42	1.28	1.45	0.15	0.33	......	5.84	
	1866	0.25	0	....	0.32	....	....	....	....	*0.83	0.60	....	6.02	......	....	
	1867	0.61	0.60	0.57	0.47	0.20	0	7.60	4.60	*1.30	4.60	0	2.75	*23.30	14.17	
	1868	0.75	*1.63	0.25	0.85	0	0	4.90	*2.39	1.30	0.50	0 40	1.40	*14.37	9.44	
	1869	3.30	4.20	0.20	1.50	0.80	1.48	1.50	3.40	0.40	0.11	1.56	0.69	19.14	9 08	
	1870	0.10	0.87	1.86	1.20	0.20	0.66	3.88	3.23	0.73	1.50	0.15	2.21	16.59	9.90	
	1871	2.65	5.05	0.58	1.80	0.31	*0.67	2.37	1.20	2.80	1.20	1.33	2.29	*22.25	9.15	
	1872	3.30	1.59	0.63	1.99	3.00	2.25	1.10	3.15	0.50	2.75	*0.71	0.50	*21.47	11.99	
	1873	0.75	11.20	*0.94	0.15	0.20	3.15	0.26	2.64	3.60	0.50	0.55	2.00	*25.95	10.01	
	1874	1.85	0.44	0.55	0.07	0.30	0.03	1.94	1.10	0.10	0.48	0.22	0.47	7.55	3.54	
	1875	0.33	1.07	0.91	0.14	0.50	0.33	1.23	1.01	3.19	0.10	1.55	0.37	10.73	6.40	
	1876	0.75	0.48	1.55	0.22	0.24	0.17	2.32	2.44	1.54	0.80	0.61	0.21	11 33	6.93	
	1877	0.91	0.29	0.51	2.70	1.47	0.66	0.61	0.36	0 97	0.53	0.20	0.88	10.09	6.77	
	1878	1.68	1.05	1.88	1.27	0.52	1.18	3.78	5.90	0.90	0	2.12	0.59	20.87	13.55	
	1879	0.53	1.36	0.70	0.23	0	0	0.37	0.29	0.80	0.68	0 51	0.90	6.37	1.69	
	1880	0.72	0.21	0.96	0.72	0.04	0.19	3.55	1.49	0.31	1.81	0.20	0.86	11.06	6.30	
	1881	0.16	0.05	0.99	0.42	0.18	0	3.48	3.18	2.55	2 38	0.19	0.35	13.93	9.81	
	1882	1.24	1.02	0.40	0.40	0.14	2.06	3.08	2.90	0.72	0	1.68	0.68	14.32	9 30	
	1883	1.18	0.60	1.24	0.22	0.78	0	4.64	2.74	0.46	1.14	0	1.44	14.44	8.84	
	1884	*1.14	0.50	1.16	*1.14	1.04	1.18	1.78	4.64	0.76	1.66	*0.71	0.74	*16 45	10.54	
	1885	0.46	*1.63	*0.94	*1.14	1.14	6.68	2.28	1.14	1.32	0.86	1.46	1.00	*14.05	7.70	
	1886	2.52	0.94	0.82	1.08	0.24	0.34	0.42	2.96	1.06	1.50	0.46	0.10	12 44	6.10	
	1887	0.52	1.72	0.20	0.90	0.22	1.24	2.94	3.20	3 26	1.10	1.04	1.10	17.44	11.76	
	1888	1.08	1.30	1.38	2.36	0.24	0.04	2.02	0.24	0.42	0.50	0.76	1.06	11 40	5.32	
	1889	1.15	1.60	*0.94	*1.14	*0.52	0.30	2.54	0.75	*1 30	0.41	0.47	1.10	*12.22	6.55	
	1890	1.44	1.79	2.70	1.00	0	0.10	2.03	2.29	2.94	0.95	1.20	1.43	17.87	10 56	
	1891	0.81	2.07	2.40	0.10	0.95	0.60	1.86	1.23	3 40	0	0	0.85	14.27	8.14	
	1892	0.52	1.40	0.90	1.05	0.33	T.	2.09	0.30	0.04	1.39	0	0.70	8.72	3 81	
	1893	0.48	0.63	1.10	0	1.25	T.	3.60	0.60	1.50	0	0.30	0.15	9.61	6.95	
	1894	0.55	1.85	1.30	0.80	0.02	0	1.91	3.33	1.13	1 27	0	2.32	14.48	7.19	
	1895	2.05	0.70	T.	0.30	1.80	0.57	1.23	2.70	0.19	1.80	3.60	2.20	18 14	6.79	
	1896	0.12	1.20	0.45	0.90	T.	T.	1.94	2.05	1 17	2.35	0.30	0.15	10.63	6.06	
	1897	0.41	4.20	1.60	0.11	0.70	0.25	0.91	1.03	3.11	3.67	0.40	2.55	17.94	6.11	
	1898	0.66	0.30	0.46	0.20	0.18	1.78	3.83	2.23	0.21	0	2.60	1.44	13.89	8.43	
	1899	0.28	0.68	0.70	0.10	0.10	0.42	3.25	1.25	0 85	0.85	0.30	0.25	8.40	5.97	

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
	1900	0.25	0.60	0.83	2.60	0.65	0.50	0.25	0.83	1.06	0.74	0.89	0.20	9 40	5.89	
	1901	0.35	1.17	0.68	0.20	1.10	0.41	0.92	2.34	0 21	0.92	1.25	0.17	9.72	5.18	
	1902	1.95	0.59	1.04	0.66	1.56	T.	0.68	1.72	1.62	0.06	1.27	1.22	12 37	6.24	
	1903	0.46	0.92	0.45	1.27	1.05	1.36	1.18	1.82	1.77	0	0	0.06	10.34	8.45	
	1904	0.17	0.57	1.42	0.36	0.22	0.85	2.55	5.65	0.67	1.29	0	2.27	15.96	10.24	
	1905	2.30	2.31	2.85	4.05	0.50	1.50	1.15	1.00	1.55	0.30	2.70	1.00	21.21	9.75	
	1906	0.45	1.05	4.80	4.65	0.60	0	3.45	2.10	2.40	0 60	1.28	1.58	22.96	13.20	
	1907	1.38	0.88	0.63	1.19	0.86	2.45	1.48	6.22	0.30	2.00	0.80	0.98	19 17	12.50	
	1908	1.28	1.62	0.92	1.73	1.98	0.25	1.37	4.17	1 59	0.30	0.37	0.10	15.68	11.09	
	1909	0.32	0.70	0.29	0.23	0.08	0.02	2.40	5.40	4.56	T.	0.13	0.87	15 00	12.69	
	1910	0.29	0.27	0.68	1.66	T.	0.30	2.40	1.50	0 80	0.80	0.49	0.65	9.84	6.66	
	1911	1.10	1.93	.....	....	.....	.....	....	.....	.....	....	.....	....	......	.....	
Mean		0.97	1.32	1.04	1.00	0.58	0.66	2.25	2.38	1.38	1.03	0.78	0.97	14.36	8.91	
Av. No. days with precipitation ..		4	4	5	4	4	2	7	8	4	3	3	4	52	29	17
Av. snowfall, in..		7.1	8.8	4.9	2.3	1.2	0	0	0	0	0.7	5.8	7.1	37.9		15
Temperature—																
Mean		30.7	34.6	41.3	48.6	58.1	67.9	71.9	69.5	63.0	52.0	40.6	32.8	50.9		46
Mean Max.		46.1	49.3	55.3	63.0	70.8	81.1	84.6	82.4	77.3	67.7	57.8	47.2	65.2		14
Mean Min.		18.1	22.4	26.1	32.8	39.6	49 7	54.7	54.2	46.8	34.8	26.1	17.4	35.2		14
Highest		72	70	78	79	94	100	99	99	92	92	83	82	100		25
Lowest		–12	–15	–2	9	10	23	35	34	26	14	–13	–11	–15		25
Prevailing wind..		W	W	W	W	W	W	W	W	W	W	WSW	W	W		14
Days clear		17	15	17	18	19	23	12	11	19	22	19	20	212	102	
Days partly cl'dy.		7	7	9	7	8	5	14	12	8	5	6	5	93	54	
Days cloudy		7	6	5	5	4	2	5	8	3	4	5	6	60	27	

Frost—Average date of first killing frost in autumn, Oct. 2.
Average date of last killing frost in spring, May 17.
Earliest date of killing frost in autumn, Sept. 12.
Latest date of killing frost in spring, June 11.
Average length of grownig season, 138 days.
Years recorded, 18.

*Computed from nearby stations.

This is a large western border county, with much rough broken mesa and low mountain country, touching, however, 8,000 to 10,000 feet over the Chacra Mountains in the northeast, the Zuni Mountains in the southwest and Mount Taylor district in the southeast. There is an irrigated district for the Zuni Indians in the extreme southwest portion of the county, but the lands of the county are largely more suitable for grazing. There is a mean annual precipitation of about 11 to 14 or 16 inches; mean annual temperature of 50 degrees, with maximum 90 to 100 degrees in summer and zero to 10 degrees below in winter. Winds are prevailing westerly and there is much bright, sunshiny, dry weather. Owing to altitude and clear skies the growing season is short, with late spring frosts.

Average annual precipitation, 11 to 14 inches, to 16 inches in mountains.

Average seasonal precipitation, 8 to 12 inches.

Average seasonal snowfall, 30 to 50 inches.

Mean annual temperature, 50 to 51 degrees.

Mean summer temperature, 70 degrees.

Mean winter temperature, 33 degrees.

Very little farming is carried on in this county, as there are no permanent streams and the seasonal rainfall is insufficient to insure the successful growing of many of the crops; beans, corn, oats, wheat, barley, rye and potatoes being, as a rule, the more dependable ones. Irish potatoes are grown successfully in the higher altitudes, particularly in the Zuni Mountains, where there is considerable rainfall and where most of the farming is done.

Wherever water can be had for irrigation, either from springs, pumping plants or artesian wells, a large variety of crops, such as alfalfa, corn, beans, wheat, barley, oats, beets, cabbage, peas, onions and turnips, could be depended upon in the flatter sections of the county. In these high altitude counties it should be kept in mind that it is imperative to select the earlier ripening varieties of these crops, because

if the later ripening varieties are planted, in some cases, at least, they may not mature properly before the fall frost comes.

This county is excellently adapted to the raising of sheep and cattle, which is a profitable industry.

MORA COUNTY

STATION—FORT UNION. APPROX. LATITUDE—35° 54′. LONGITUDE—104° 54′. ELEVATION—6,835 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Precipitation	1851	.....	.....	.....	.....	.....	.....	.....	.....	4.63	0.61	1.97	0.33	......	.....	
	1852	0.48	0.59	0.00	0.24	0.73	7.05	2.73	5.49	3.03	3.44	2.83	0.02	26.64	19.28	
	1853	0.19	0.08	0.77	0.32	0 91	0.11	4.19	3.42	1.59	1.29	0.38	0.18	13.43	10.54	
	1854	0.07	0.02	0.63	0.46	0.50	0.69	3.98	1.75	2.99	0.88	1.80	0.60	14.37	10.37	
	1855	0.00	0.00	0.40	0.00	2.88	2.12	4.37	1.46	3.83	0.40	2.20	0.91	18.57	14.66	
	1856	0.76	1.08	1.11	1.06	0.56	0.65	3.39	6.74	4.04	0.00	0.70	0.12	20.21	16.44	
	1857	0.70	0.11	0.12	0.98	0 25	2.49	4.03	2.96	4.33	3.32	1.10	0.55	20.94	15.04	
	1858	1.13	1.36	1.15	0.40	1.20	3.20	5.80	5.71	0.40	0.30	0.72	1.42	22.79	16.71	
	1859	0.25	0.00	1.00	0.65	0.00	4.80	5.76	7.18	3.55	1.10	0.00	0.25	24.54	21.94	
	1860	1.28	0.92	*0.48	0.44	*1.57	3.45	1.54	3.95	1.50	T.	0.56	0.80	*16.49	12.45	
	1861	1.09	0.30	T.	0.64	T.	4.14	.....	.....	.....	0.00	0.00	.....	......	.....	
	1862	0.20	0.12	0.76	0.28	1.18	2.39	12.60	3.30	*2.04	*0.64	0.29	0.25	*24.05	21.79	
	1863	0.75	T.	0.65	0.03	0.60	.....	.....	.....	.....	.....	.....	.....	......	.....	
	1864	0.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	......	.....	
	1865	.....	.....	.....	.....	.....	0.00	.....	.....	.....	.....	.....	.....	......	.....	
	1866	.....	.....	.....	.....	.....	.....	.....	.....	.....	0.32	.....	.....	......	.....	
	1867	.....	.....	0.00	0.18	0.67	0.17	0.93	4.84	1.01	1.10	0.00	0.00	......	7.80	
	1868	.....	.....	1.25	0.31	0.76	1.04	3.72	5.23	0.20	0.27	0.00	.....	......	11.26	
	1869	.....	.....	.....	0.41	3.76	2.80	0.30	0.70	0.00	0.00	0.20	1.00	......	7.97	
	1870	0.20	0.00	0.10	0.10	T.	1.60	4.80	1.75	1.70	0.10	T.	0.03	10.38	9.95	
	1871	0.50	*0.44	0.04	0.16	0.20	1.02	2.49	5.31	2.77	0.38	0.22	0.10	*13.63	11.95	
	1872	0.50	0.54	0.56	0.76	3.46	4 05	8.12	3.47	*2.04	T.	0.24	T.	*23.74	21.90	
	1873	*0.58	0.30	0.04	0.04	*1.58	3.38	3.30	7.38	0.84	T.	0.00	0.22	*17.65	16.51	
	1874	0.54	1 26	0.32	0.94	4.38	1.10	1.24	1.68	3.04	1.24	0.86	1.08	17.68	12.38	
	1875	0.20	0.30	2.52	0.20	5.96	1.50	6.70	5.16	4.76	0.00	0.84	T.	28.14	24.28	
	1876	0.20	T.	0.08	0.30	0.80	2 24	4.30	4.36	3.08	0.04	*0.51	*0.58	*16.59	15.18	
	1877	0.12	2.70	0.36	2.08	1.50	0.24	4.50	4.90	4.82	0.16	0.20	0.60	22.18	18.04	
	1878	0.12	*0.44	1.16	*0.87	0.42	4.46	*4.28	3.88	0.18	0.00	3.90	0.30	*20.01	14.09	
	1879	0.40	0.30	T.	0.12	0.06	0.30	2.46	0.48	0.36	1.24	*0.51	0.12	*6.35	3.78	
	1880	*0.58	*0.44	0.08	T.	1.28	0 25	7.98	*4.68	0.82	0.89	0.64	0.48	*18.12	15.01	
	1881	1.29	0.90	0.30	2.03	1.51	0.30	4.74	4.59	2.50	3.74	0.56	0.10	22.56	15.67	
	1882	0.32	*0 44	*0.48	0.88	1.30	2.24	2.60	3.30	T.	T.	*0.51	0.16	*12.13	10.32	
	1883	0.14	0.12	*0.48	0.22	0.10	0.28	2.80	4.81	2.96	1.94	T.	1.12	*14.97	11.17	
	1884	0.18	0.54	0.28	0.28	4.93	3 06	0.76	7.80	1.08	*0.64	T.	2.00	*21.55	17.91	
	1885	0.24	0.30	0.42	0.72	2.15	3.54	2.51	4.76	1.24	0.58	0.10	1.42	17.98	14.92	
	1886	0.98	T.	0.50	3.22	0.18	1.66	1.18	8.04	3.94	0.96	0.35	0.45	21.46	18.22	

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
	1887	0.45	*0.44	0.03	1.91	2.72	4.23	2.83	1.82	1.70	1.70	0.40	3.75	*21.98	15.21	
	1888	3.10	0.09	2.05	2.16	0.70	2.58	4.36	8 28	0.18	0.82	0.92	0.30	25.54	18.26	
	1889	1.20	T	0.00	0.50	1.27	2.60	2.73	2.30	0.58	0.45	0.45	T.	12.08	9.98	
	1890	T.	0.11	0.14	3.96	0.03	1.30	5.10	2.31	0.59	0.22	0.83	0.14	14.73	13.29	
	1891	0.33	0.32	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	
	1895	.....	.....	.....	.....	3.34	1.31	7.12	2.72	.....	1.17	0.38	0.40	.....	.....	
	1896	T.	.....	.....	.....	T.	.....	.....	.....	.....	3.52	T.	0.08	.....	.....	
	1897	0.20	0.05	0.82	0.70	9.73	3.39	2.36	4.33	1.16	6.43	0.00	T.	29.17	21.67	
	1898	0.39	0.60	0.02	2.17	0.49	3.20	5.74	3.75	1.35	0.35	0.63	1.50	20.19	16.70	
	1899	T.	0.50	0.95	0.17	T.	0.95	3.98	0.52	4.92	0.60	1.10	T.	13.69	10.54	
	1900	0.60	0 25	0.52	1.55	5.75	4.67	3.03	1.73	5.03	1.63	0.20	0.30	25.26	21.76	
	1901	0.10	0.80	0.50	0.95	5.92	1.47	2.78	3.71	2.10	2.30	0.95	0.20	21.78	16.93	
	1902	0.07	T.	0.60	0.05	2.00	0.15	1.58	3.05	0.55	0.42	0.58	0.84	9.89	7.38	
	1903	T.	1.60	0.11	0.54	1.05	6.69	0.78	2.02	1.93	0.05	0.00	0.05	14.82	13.01	
	1904	T.	0.17	0.13	0.32	0.59	2.07	4.20	2.01	6.84	1.30	0.27	0.70	18.60	16.03	
	1905	1.00	1.90	2.44	3.30	0.38	1.50	1.07	1.62	1.44	1.54	3.48	0.50	20.17	9.31	
	1906	0.07	0.58	0.30	1.72	0.58	2.57	8.09	2.40	3.01	3.10	1.00	1.23	24.65	18.37	
	1907	0.88	T.	0.08	1.26	1.39	1.32	5 25	5.02	0.82	0.70	0.66	T.	17.38	15.06	
	1908	0.11	0.48	T.	1.92	0.65	1.35	6.27	4.78	0.80	1.23	0.77	0.05	18.41	15.77	
	1909	0.04	0 26	1.11	0.40	1.17	2.63	2.88	3.78	3.37	1.45	0.42	0.43	17.94	14.23	
	1910	0.17	0.07	0.57	1.66	0.40	3.40	4.20	6.17	0.68	0.47	0.38	0.23	18.40	16.51	
	1911	0.05	0.91	0.05	1.03	3.30	1.61	3 47	2.36	1.14	2.68	0.36	0.45	17.41	12.91	
	1912	T.	0.85	0.39	0.67	2.35	4.40	1.59	4.04	0.80	0.42	0.00	0.19	15.70	13.85	
	1913	0.30	0 53	0.46	0.98	0.45	11.64	0.80	2.56	1.95	0.50	0.65	1.54	22.36	18.38	
	1914	T.	T.	0.11	0.82	3.75	4.20	8.02	4.80	0.58	2.14	0.00	0.63	25.05	22.17	
	1915	0.30	0.57	0.77	4.16	2.65	0.54	3.13	4.88	0.86	0.32	0.25	0.14	18.57	16.22	
	1916	0.75	0	0.65	1.14	0.25	0.72	3.62	4.62	0.95	3.95	T.	0.10	16.75	11.30	
	1917	0.27	0.28	0.05	0.32	1.50	0.84	3.06	2.20	3.37	0.15	0.47	T.	12.51	11.29	
Mean		0.42	0.45	0.52	0.94	1.65	2.39	3.86	3.87	2.07	1.12	0.64	0.51	18.44	14.78	
Av. No. days with precipitation ..		1	2	3	5	6	7	11	11	6	3	2	2	59	46	20
Av. snowfall, in...		1.6	5.4	3.3	1.7	0.1	0	0	0	T.	0.9	2.6	4.7	20.3		19
Temperature—																
Mean		32.0	34.4	40.5	47.4	56.3	64.9	66 9	66.7	60.4	49.5	40.1	33.0	49.3		58
Mean Max.		50.0	49.2	55.7	61.9	69.7	78.0	80.6	80.1	75.5	66.2	58.0	48.2	64.4		20
Mean Min.		16.7	16.6	22 7	29.2	37.3	45.9	50.9	49.5	42.2	31.7	23.5	14.9	31.8		20
Highest		76	78	81	79	90	99	96	97	95	87	82	78	99		20
Lowest		–30	–27	–23	1	10	28	33	39	21	5	–9	–13	–30		22

MORA COUNTY (Continued)

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Prevailing wind..		W	SW	SW	W	SW	SW	SW	SW	SW	W	W	NW	SW		14
Days clear		26	21	21	21	20	20	16	17	22	24	25	25	259	116	21
Days partly cl'dy.		3	3	4	4	7	8	13	12	6	3	1	3	67	50	21
Days cloudy		2	4	5	5	4	2	2	2	2	4	4	3	39	17	21

Frost—Average date of first killing frost in autumn, Oct. 5.
Average date of last killing frost in spring, May 16.
Earliest date of killing frost in autumn, Sept. 4.
Latest date of killing frost in spring, June 18.
Average length of growing season, 141 days.

*Computed from nearby stations.

This is one of the northeast counties of the state, with much mesa and rolling plateau land above 6,000 feet in altitude, rising on its western border to the crest of the Sangre de Cristo range, well above 12,000 feet. This gives a wide variation in climate and cultural possibilities. In the central and eastern mesa districts there is an annual precipitation of 15 to 18 inches, increasing to 18 or 20 inches in the foothills, and to 20 to 25 inches over the mountains. Albert, Union County, well represents the eastern mesa climate. Mean annual temperature 49 to 51 degrees; maximum 90 to 100 degrees each summer, and minimum zero to 10 below, with an occasional record of 20 degrees below. The mountains are, of course, much colder, with short seasons, long winters and much snow. The precipitation, temperature and other weather data given for Albert, Union County, can be applied to the eastern part of Mora County, around Roy.

Average annual precipitation, 15 to 18 inches, to 20 to 25 inches in mountains.

Average seasonal precipitation, 12 to 15 inches.

Average seasonal snowfall, 20 to 30 inches, to 50 and 80 inches in mountains.

Mean annual temperature, 49 to 52 degrees.

Mean summer temperature, 66 to 70 degrees.

Mean winter temperature, 33 to 38 degrees.

Practically the same crops that are raised in San Miguel County can be raised in this county. Along the Mora River Valley considerable irrigation farming is carried on; and alfalfa, wheat, barley, oats, peas, corn, cabbage, onions, beans, celery, carrots and turnips are among the leading crops. Some fruit, principally apples, is raised in this valley. The potato is more dependable in the higher altitudes in the western part of the county. Considerable dry farming is also done, particularly in the central and eastern parts, where the New Mexico Pinto bean, wheat and corn are the principal dry land crops. Some milo, kafir and Sudan grass are also grown, in the lower portions. Because of the large mesa and plateau areas and the comparatively high precipitation, the agricultural possibilities are very promising.

The grazing conditions are most excellent on the mesas, plateaus and in the mountains; and for years this county has been noted for its cattle and sheep raising industries.

OTERO COUNTY

STATION—ALAMOGORDO. APPROX. LATITUDE—32° 52′. LONGITUDE—105° 58′. ELEVATION—4,338 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Precipitation	1889	....	....	....	....	....	....	....	....	....	....	0.33	....	....	....	
	1890	....	T.	0.00	0.15	....	....	....	....	....	0.67	0.89	....	....	....	
	1891	1.00	1.12	....	....	....	....	....	0.89	0.91	0.00	T.	0.78	....	....	
	1892	0.79	0.55	0.61	T.	T.	0 09	1.23	0.51	0.11	1.65	0.21	1.21	6.96	2.55	
	1893	0.20	0.30	0.11	0.00	0.87	0.04	0.92	3.90	4.00	0.40	0.20	0.26	10.66	9.84	
	1894	0.15	0.70	0.77	0.01	0.02	0.15	0.88	2.45	....	....	....	....	....	....	
	1898	0.63	0.17	0.54	0.67	T.	3.13	6.30	4.77	1.53	T.	0.52	0.97	19.23	16.94	
	1899	0.33	....	....	....	....	....	....	....	....	....	....	....	....	....	
	1901	*0.15	*1.35	*0.35	0.41	0.22	0.38	1.47	1.14	1.18	2.59	2.13	0.10	11.47	5.15	
	1902	T.	0.16	0 22	0.00	T.	0.17	1.38	3.39	0.53	0.65	0.15	0.60	7.25	5.69	
	1903	0.30	1.00	0.40	T.	0.48	1.30	0.83	1.48	1.16	0.00	0.00	T.	6.95	5.65	
	1904	*0.50	*0.10	0.00	0.00	T.	0 13	0.81	2.01	2.10	2.38	0.17	0.75	8.95	5.05	
	1905	1.02	2.45	1.85	3.34	T.	1.84	2.88	0.41	1.78	0.34	2.75	0.86	19.52	12.10	
	1906	0.85	0.74	0 26	0.99	0.27	T.	0.72	1.91	0.42	0.43	2.22	2.35	11.16	4.57	
	1907	1.45	0.07	T.	0.35	0.23	0.78	0.93	3.74	1.74	0.84	0.75	T.	10.88	7.77	
	1908	1.15	0.30	0.42	1.29	0.08	0 13	4.30	3.06	0.26	0.19	0.83	T.	12.11	9.54	
	1909	0.95	T.	1.00	0.00	0.00	0.17	0.62	1.88	1.14	0.13	0.02	0.94	6.85	4.81	
	1910	0.40	0.00	0.20	0.12	0.04	1.00	0.99	4.05	T.	0.70	1.10	0.05	8.65	6.40	
	1911	0.21	1.96	0.62	0.84	0.94	0.54	2.75	0.59	2.31	1.46	0.18	0.29	12.69	7.97	
	1912	0.04	0.61	0.47	0.55	0.14	0.46	0.22	4.11	1.00	1.56	T.	0.45	9.61	6.48	
	1913	0.57	1.77	0.05	0.89	0.05	1.66	0.01	1.87	2.05	0	1.90	1.56	12.38	6.53	
	1914	0.06	0.26	0.72	0 36	2.11	2.56	4.78	2.05	0.60	1.79	1.13	2.61	19.03	12.46	
	1915	0.59	0.66	1.67	2.02	0.03	T.	1.92	0.71	5.45	0.04	0	0.91	14.00	10.13	
	1916	1.35	0.09	0.91	0.20	1.06	T.	1.38	2.44	1.21	3.35	T.	0.47	12.46	6.29	
	1917	0.34	0.04	0.01	T.	0.63	0.10	0.55	3.06	0.36	T.	0.11	0.00	5.20	4.70	
Mean		0.58	0 66	0.53	0.57	0.34	0.70	1.71	2.29	1.42	0.86	0.67	0.72	11.05	7.03	
Av. No. days with precipitation ..		2	3	2	3	1	2	6	7	3	2	2	3	36	22	6
Av. snowfall, in..		1.8	1.8	1.6	0.4	0	0	0	0	0	T.	0.5	2.0	8.1		9
Temperature—																
Mean		44.3	45.6	53.6	59.9	67.8	77.8	79.8	78.2	72.3	60.4	50.7	42.0	61.0		10
Mean Max.		58.9	60.0	69.1	77.3	85.5	95.5	95.5	92.9	87.4	76 2	64.8	56.0	76.6		10
Mean Min.		30.1	31.0	38.0	42.6	50.0	60.2	64.2	63.6	57.3	44.5	35.1	28.3	45 4		10
Highest		78	79	90	92	100	108	109	108	100	98	84	75	109		10
Lowest		9	4	10	25	30	41	53	48	38	24	12	0	0		10

OTERO COUNTY (Continued)

	Year	Jan.	Feb.	Mar.	Apr.	May.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Prevailing wind..		W	SW	W	W	SW	SW	SW	SW	SW	SW	SW	SW	SW		
Days clear		19	16	19	20	22	18	12	14	18	23	21	18	220	104	
Days partly cl'dy.		9	9	9	8	8	10	16	14	10	6	7	8	113	66	
Days cloudy		3	4	3	2	1	2	3	3	2	2	2	5	32	13	

Frost—Average date of first killing frost in autumn, Oct. 25.
Average date of last killing frost in spring, April 11.
Earliest date of killing frost in autumn, Oct. 9.
Latest date of killing frost in spring, April 30.
Average length of growing season, 197 days.

*Computed from nearby stations.

NOTE—Record at La Luz, 4 miles northeast, from November, 1889, to January, 1889.

This is a southern border county. Its lower altitudes range from 4,000 to 5,000 feet, including the Tularosa Basin; but the altitude increases along its northeast and east sides in the Sacramento and White Mountain ranges to over 10,000 feet. Over the mountains there is a marked increase in precipitation, which in the lower levels is small, averaging from 10 to 12 inches. Prevailing winds are southwesterly and fresh over the lower country, but often light for long periods in the mountains. Much clear, bright weather obtains over the lower country, which is warm and dry, but showers are frequent in the mountains.

Average annual precipitation, 10 to 12 inches, to 20 inches in mountains.

Average seasonal precipitation, 7 to 9.5 inches, to 15 inches in mountains.

Average seasonal snowfall, 8 to 15 inches, to 50 inches in mountains.

Mean annual temperature, 50 to 61 degrees.

Mean summer temperature, 67 to 78 degrees.

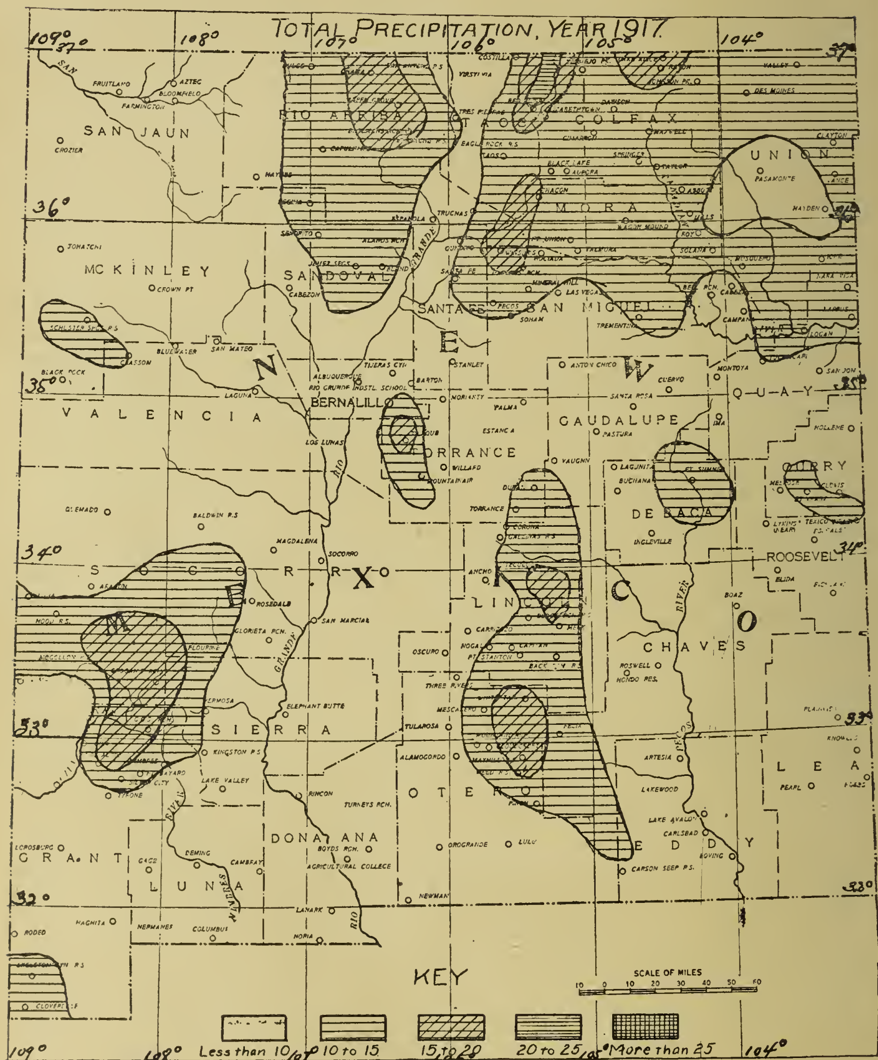
Mean winter temperature, 33 to 44 degrees.

Considerable irrigation and dry farming is done in the county. On the west side of the mountains, the principal irrigated districts are Three Rivers, Tularosa, La Luz and Alamogordo. Some of the principal crops grown in these irrigated areas are alfalfa, corn, wheat, barley, oats, beans, field peas, tomatoes, squash, chile and sweet corn. In the irrigated intermontane districts higher up in the mountains on both the east and west slopes, cabbage, cauliflower, celery, carrots, beets, peas, sweet corn, lettuce, and some Irish potatoes are among the more important vegetables. Wheat, oats, barley and short season corn are raised. Apples are grown extensively in the High Rolls, Mountain Park and a few other high altitude districts; and the Delicious, Winesap, Jonathan, White Winter Pearmain and Gano are the principal winter varieties. Sour cherries do well also. In the higher altitudes in the mountains where there is considerable rainfall for dry farming, oats, barley, wheat, beans, peas, short season corn, Irish potatoes, turnips and other root crops are raised. In the lower basins, both east and west of the mountains, little or no dry farming is being carried on, because of the limited amount of rainfall. Some pump irrigation

is practiced in a number of places in the Tularosa Basin. Wherever water for irrigation can be had the soils are capable of producing good yields.

Cattle and sheep raising are important industries in this county, on account of the excellent grazing afforded by the mountain and mesa ranges.


TOTAL PRECIPITATION, YEAR 1915.
SAN JAUN
MC KINLEY
RIO ARRIBA
TAOS
COLFAX
UNION
MORA
SANDOVAL
SANTA FE
SAN MIGUEL
BERNALILLO
VALENCIA
TORRANCE
GUADALUPE
QUAY
DE BACA
CURRY
ROOSEVELT
SOCORRO
LINCOLN
CHAVES
SIERRA
OTERO
EDDY
DONA ANA
GRANT
LUNA
NEW MEXICO
KEY
Less than 10
10 to 15
15 to 20
20 to 25
More than 25
SCALE OF MILES
109°
108°
107°
106°
105°
104°
103°
37°
36°
35°
34°
33°
32°


TOTAL PRECIPITATION, YEAR 1917
109°
108°
107°
106°
105°
104°
37°
36°
35°
34°
33°
32°
SAN JAUN
RIO ARRIBA
TAOS
COLFAX
UNION
MORA
MC KINLEY
SANDOVAL
SANTA FE
SAN MIGUEL
BERNALILLO
VALENCIA
TORRANCE
GAUDALUPE
QUAY
CURRY
DE BACA
ROOSEVELT
SOCORRO
LINCOLN
CHAVES
SIERRA
OTERO
DONA ANA
GRANT
LUNA
EDDY
LEA
NEW MEXICO
RIO GRANDE
PECOS RIVER
KEY
Less than 10
10 to 15
15 to 20
20 to 25
More than 25
SCALE OF MILES
10 0 10 20 30 40 50 60

QUAY COUNTY

STATION—SAN JON. APPROX. LATITUDE—35° 6′. LONGITUDE—103° 20′. ELEVATION—4,200 FEET.

	Year	Jan.	Feb.	Mar.	Apr.	May.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Precipitation	1907	....	....	....	....	....	4.54	1.19	4.65	0.08	1.73	0.66	1.15	.....	.....	
	1908	0.36	0.84	T.	1.12	0.45	T.	1.16	4.22	0.97	0.37	0.51	T.	10.00	7.92	
	1909	T.	T.	0.92	0.20	1.21	1.54	1.67	2.12	1.94	2.06	1.13	0.29	13.08	8.68	
	1910	0.03	0.08	0.20	0.46	0.39	1.28	1.40	4.74	0.13	0.23	0.08	0.01	9.03	8.40	
	1911	0.03	1.19	0.03	1.14	2.26	1.37	2.38	5 84	0.38	1.52	0.48	0.38	17.00	13.37	
	1912	T.	1.89	0.11	1.03	2.32	1.53	2.98	2.33	1.47	0.11	0.00	0.47	14.24	11.66	
	1913	0.30	0.27	0.14	3.05	1.01	1.37	1.79	0.45	1.14	1.45	2.25	1.42	14.64	8.81	
	1914	0.10	0.15	0.10	1.34	5.47	1.61	3.91	2.14	0.50	3.39	0.06	0.99	19.76	14.97	
	1915	0.43	0.82	0.74	4.17	2.42	2.36	3.37	3.65	3.88	1.20	0.02	0.01	23.07	19.85	
	1916	0.55	T.	0.31	1.36	0.20	1.75	1.15	6.98	0.63	0.77	0.25	0.61	14.61	12.12	
	1917	0.30	0.03	0.16	0.20	2.14	0.79	1.49	2.23	1.90	0.11	0.19	0.02	9.56	8.75	
Average		0.21	0.53	0.27	1.42	1.79	1.65	2.04	3.58	1.19	1.18	0.51	0.49	14.85	11.66	
Av. No. days with precipitation ...		2	3	3	5	6	6	8	8	5	4	3	3	56	38	9
Av. snowfall, in..		1.8	4.5	1.8	0.3	T.	0	0	0	0	0.9	1.8	4 6	15.7		8
Temperature—																
Mean		40.0	40.6	48.7	57.0	65.4	74.8	78.6	77.2	70.6	58.4	47.4	36.0	57.9		
Mean Max.		55.4	55.9	64.5	72.2	80.6	89.8	92.1	90.4	84.4	73.3	62.9	49.8	72.6		10
Mean Min.		24.5	25.4	32.9	41.7	50.2	59.9	65.0	63 9	56.7	43.5	31.9	22.2	43.2		10
Highest		78	81	87	93	98	105	106	105	99	92	91	77	106		10
Lowest		–19	–9	–3	19	22	37	50	45	34	16	0	–9	–19		10
Prevailing wind..		SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW		8
Days clear		20	17	20	19	20	19	17	18	23	23	22	19	237	1.16	10
Days partly cl'dy.		7	7	6	6	6	7	10	8	4	4	4	6	75	41	10
Days cloudy		4	4	5	5	5	4	4	5	3	4	4	6	53	26	10

Frost—Average date of first killing frost in autumn, Oct. 25.
Average date of last killing frost in spring, April 25.
Earliest date of killing frost in autumn, Oct. 8.
Latest date of killing frost in spring, May 9.
Average length of grownig season, 185 days.
Years recorded, 8.

QUAY COUNTY

STATION—TUCUMCARI. APPROX. LATITUDE—35° 10′. LONGITUDE—103° 48′. ELEVATION—4,194 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Precipitation	1904	....	....	....	....	....	....	....	....	....	....	....	T.	.....	.....	
	1905	0.53	1.15	2.96	2.10	2.25	2.50	4.07	1.01	2.50	T.	4.00	1.00	24 07	14.43	
	1906	0.70	0.70	0.05	1.79	1.00	0.46	4.21	2.92	0.33	0 62	1.66	1.61	16.05	10.71	
	1907	0.24	0.00	0.00	2.31	2.30	3.36	2.56	3.92	0.08	1.43	0.75	0.80	17.75	14.53	
	1908	0.20	0.90	0.00	1.60	0.24	0.44	3.45	1.78	1.03	0 93	0.98	T.	11.55	8.54	
	1909	T.	T.	1.72	0.48	0.97	2.42	2.03	1.04	0.85	1.90	159	0.20	13.20	7.79	
	1910	0.09	0.04	0.09	0.76	0.16	0.26	1.77	5.88	0.49	0 45	0.22	0.15	10.36	9.32	
	1911	0.13	1.70	0.17	0.68	0.92	1.13	2.90	5.01	2.75	1.89	0.40	0.74	18 42	13.39	
	1912	0.00	2.40	0.15	1.01	1.50	1.57	3.11	3.74	1.16	0 10	0.00	0.13	14.87	12.09	
	1913	0.28	0.64	0.16	4.00	1.21	3.05	0.56	1.97	1.58	0.08	2.09	2.62	18 24	12.37	
	1914	0.16	0.32	0.32	2.18	9.36	1.30	4.46	1.02	1.31	3 75	0.00	0.86	25.04	19.63	
	1915	0.75	0.98	1.03	4.57	1.48	0.82	3.13	2.28	2.94	0.67	T.	0.27	18 87	15.22	
	1916	0.70	0.00	0.09	1.55	0.56	0.63	1.16	4.43	0.56	0 78	0.29	0.32	11.07	8.89	
	1917	0.58	0.11	0.12	0.32	1.82	0.90	0.74	6.11	2.74	0.16	0.62	0.04	14 26	12.63	
Mean		0.33	0.69	0.53	1.79	1.83	1.45	2.63	3.16	1.41	0 98	0.97	0.62	16.39	12.27	
Av. No. days with precipitation ...		1	2	2	4	5	4	7	7	4	2	2	2	42	31	11
Av. snowfall, in..		2.6	6.5	3.8	2.1	T.	0	0	0	0	1.1	6	5	271		10
Temperature—																
Mean		41.8	40.9	50.2	57.1	65.3	75.5	78 2	77.7	71.3	58.8	48.6	38.3	58.6		11
Mean Max.		57.0	56.0	66.0	72.5	80.1	90.2	91.9	91.3	85.4	74.2	63.5	52.4	73.4		11
Mean Min.		26.6	25.8	34 4	41.7	50.5	60.8	64.6	63.9	57.3	43.4	33.7	24.8	44.0		11
Highest		80	81	92	95	99	105	105	105	99	92	85	75	105		11
Lowest		−8	−3	3	22	25	39	53	49	35	13	−1	−3	−8		11
Prevailing wind..		SW	SW	SW	SW	SW	SW	S	SW	SW	SW	SW	SW	SW		11
Days clear		24	20	22	18	21	20	19	19	21	24	21	22	251	118	
Days partly cl'dy.		4	5	5	7	6	8	9	9	5	4	4	5	71	44	
Days cloudy		3	3	4	5	4	2	3	3	4	3	5	4	43	21	

Frost—Average date of first killing frost in autumn, Oct. 25.
Average date of last killing frost in spring, April 19.
Earliest date of killing frost in autumn, Oct. 14.
Latest date of killing frost in spring, May 7.
Average length of growing season, 189 days.
Years recorded, 10.

This is an eastern border county, of moderately low altitude (3,900 to 4,500 feet), with a few isolated mountain peaks rising above 5,000 feet. It is largely a rolling, somewhat broken prairie country. The annual precipitation averages from 15 to 18 inches, giving promise of successful dry land culture. The winds of the district are prevailing southwesterly and rather high, because of the open nature of the country.

Average annual precipitation, 15 to 18 inches.

Average seasonal precipitation, 12 to 15 inches.

Average seasonal snowfall, 15 to 25 inches.

Mean annual temperature, 55 to 58 degrees.

Mean summer temperature, 75 to 78 degrees.

Mean winter temperature, 35 to 39 degrees.

This is a dry farming county; and with the exception of a few garden patches which are raised by windmill irrigation, or possibly some gravity irrigation along the Canadian River, all of the farming is done by dry farming methods. The principal crops are beans, corn, milo, kafir, feteria, broom corn, Sudan grass, cowpeas, melons, squash and pumpkins. Irish potatoes are not dependable; and while occasionally a farmer here and there may get a fair yield, it is not advisable to plant on a large scale. Over in the plains district where the elevation is a little greater, winter and spring wheat are often quite successful.

This is a grazing section, and affords good ranges for large herds of cattle and sheep. Stock raising is also becoming an imporant industry; and some attention is being given to the dairying industry by the dry farmers.

RIO ARRIBA COUNTY

STATION—CHAMA. APPROX. LATITUDE—36° 54′. LONGITUDE—106° 35′. ELEVATION—7,851 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Precipitation	1889	.....	....	....	....	....	.....	0.47	2.16	1.67	1.04	1.60	3.35	......	.....	
	1890	2.25	2.90	1.64	1.66	0.27	0.55	2.61	2.05	1.91	2.77	1.50	0.50	20.61	9.05	
	1891	2.40	7.10	3.43	0.40	2.93	0.76	3.24	*1.50	5.25	0.75	0.10	4.97	*32.83	14.08	
	1892	1.84	3.95	2.01	1.76	0.93	0.45	3.92	0.42	0	2.00	0.53	1.77	19.58	7.48	
	1893	1.73	4.32	5.15	0.30	1.27	0.14	1.48	3.62	3.99	0.25	0.85	1.60	24.70	10.80	
	1894	1.60	2.70	2.60	0.98	0.55	0.03	1.12	4.10	2.30	0.90	0.10	3.20	20.18	9.08	
	1895	5.30	2.70	2.35	....	2.58	*1.25	2.20	3.05	0.45	1.27	3.45	2.90	......	.....	
	1896	1.65	2.10	2.20	2.30	0.05	0.19	2.16	0.78	1.80	1.47	2.15	1.80	18.65	7.28	
	1897	2.58	4.90	5.53	0.79	....	.....	....	.....	....	....	....	....	......	.....	
	1905	.....	....	....	....	1.35	0.99	1.31	1.45	1.27	0.20	1.86	0.80	......	.....	
	1906	2.10	1.10	4.00	2.89	1.50	0.60	3.09	2.13	1.85	1.73	0.96	3.22	25.17	12.06	
	1907	2.03	1.70	0.94	2.90	3.71	1.03	1.90	5.13	2.44	0.92	0.20	2.40	25.30	17.11	
	1908	1.70	1.70	1.12	1.74	1.00	0.28	2.80	4.55	0.89	1.48	2.35	0.60	20.21	11.26	
	1909	1.73	2.53	0.45	1.66	1.05	0.32	2.33	3.22	1.83	1.55	1.32	3.32	21.31	10.41	
	1910	2.39	3.04	1.22	1.05	0.32	0.60	2.30	2.27	0.15	1.86	0.79	1.31	17.30	6.69	
	1911	3.04	1.68	1.53	0.86	0.49	1.55	7.94	3.39	3.46	4.15	1.65	0.75	30.49	17.69	
	1912	0.79	0.60	5.76	2.39	0.76	1.09	2.10	2.36	0.59	2.02	0.16	0.33	18.95	9.29	
	1913	1.57	3.58	2.33	0.44	0.21	1.87	1.78	1.13	2.65	1.08	2.65	3.73	23.02	8.08	
	1914	2.11	1.16	0.73	2.33	2.09	1.42	5.58	2.25	1.68	3.67	0.12	2.87	26.01	15.35	
	1915	1.64	2.68	0.55	4.87	2.88	0.32	4.52	1.87	2.52	T.	1.55	3.10	26.50	16.98	
	1916	11.29	1.48	4.07	1.49	1.05	T.	1.97	2.53	1.13	4.97	0.10	2.26	32.34	8.17	
	1917	2.76	2.15	1.51	1.97	3.17	0.10	1.88	1.15	1.24	0.00	T.	T.	15.93	9.51	
Mean		2.62	2.70	2.46	1.72	1.41	0.68	2.70	2.43	1.86	1.62	1.14	2.13	23.47	10.80	
Av. No. days with precipitation ..		8	8	8	6	5	3	9	10	6	4	4	7	78	39	16
Av. snowfall, in...		31.0	29.3	26.0	12.7	5.7	0	0	0	0.7	4.4	9.5	26.9	15.25		16
Temperature—																
Mean		23.6	25.8	33.3	42.0	49.9	58.4	64.3	63.4	56.4	46.5	36.7	25.0	43.8		19
Mean Max.		39.6	38.8	48.2	58.6	66.6	77.1	80.5	79.1	72.8	63.0	53.2	39.9	59.8		16
Mean Min.		8.4	9.9	18.1	27.1	31.8	39.2	46.9	46.7	38.6	29.0	19.5	9.2	27.0		16
Highest		69	65	73	81	89	97	97	99	94	90	79	68	99		16
Lowest		–24	–26	–20	–11	13	23	31	34	18	2	–11	–20	–26		16

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Prevailing wind..		SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW		16
Days clear		17	15	19	13	17	20	14	13	19	22	20	17	206	96	12
Days partly cl'dy.		9	9	7	12	11	9	14	15	9	7	7	9	118	70	12
Days cloudy		5	5	5	5	3	1	3	3	2	2	3	5	42	17	12

Frost—Average date of first killing frost in autumn, Sept. 21.
Average date of last killing frost in spring, May 31.
Earliest date of killing frost in autumn, Sept. 12.
Latest date of killing frost in spring, June 22.
Average length of growing season, 113 days.
Years recorded, 16.

*Computed from nearby stations.

RIO ARRIBA COUNTY

STATION—ESPANOLA. APPROX. LATITUDE—36° 0′. LONGITUDE—106° 5′. ELEVATION—5,590 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Precipitation	1895	.....	....	....	0.09	2.10	0.58	3.01	0.84	0.36	1.39	0.96	0.81	......	6.99	
	1896	0.04	0.32	0.06	0.50	0.04	0.92	1.36	0.71	1.18	2.42	T.	0.53	8.08	5.71	
	1897	0.32	0.14	0.94	0.16	3.48	0.08	0.92	1.01	2.20	0.87	*0.50	0.30	*10.92	7.85	
	1898	0.45	0	0.22	1.04	T.	0.56	2.22	1.32	0.22	0.60	0.55	0.60	7.78	5.36	
	1899	0.05	0.10	0.20	0.02	0	1.34	1.66	0.94	1.23	0.22	0.49	0	6.25	5.19	
	1900	0.10	0.27	0.10	1.57	1.30	0.68	1.07	0.48	3.27	0.73	0.30	0.33	10.20	8.37	
	1901	0.43	0.22	0.10	0.62	1.65	0.21	1.54	2.09	.....	....	.....	....	......	.....	
	1902	.....	....	....	.....	0.75	0.05	0.80	2.49	0.92	0.16	0.87	0.30	......	.....	
	1905	.....	....	....	1.01	0.12	1.62	1.18	1.01	0.29	0.26	2.98	T.	......	5.23	
	1906	T.	T.	0.37	0.95	0.75	0.45	2.19	....	.....	....	.....	....	......	.....	
	1907	*1.20	0.13	T.	2.53	0.99	0.79	2.31	5.94	*0.65	0.87	0.14	T.	*15.55	13.21	
	1908	0.16	0.90	0.39	1.01	1.05	0.20	0.94	3.05	0.41	0.35	1.38	0.40	10.24	6.66	
	1909	0.33	0.22	1.63	0.58	0.49	T.	0.48	2.45	2.51	0.84	0.09	0.37	9.99	6.51	
	1910	0.45	0.76	0	0.63	0.25	0.11	0.15	....	.....	....	0.58	0.23	......	.....	
	1911	0.34	0.99	0.10	0.79	0.59	0.90	4.25	0.37	2.02	3.64	1.35	0.04	15.38	8.92	
	1912	0.12	0.56	1.11	0.45	1.42	1.82	1.73	1.10	0.03	0.25	0.18	0.28	9.05	6.55	
	1913	0.37	0.38	0.02	0.87	0.02	1.58	0.38	0.61	0.64	0.17	1.08	0.54	7.66	5.10	
	1914	T.	T.	0.13	0.54	1.67	0.32	3.88	1.50	0.26	1.67	0	1.13	11.10	8.17	
	1915	0.66	0.60	0.72	3.57	0.73	0.42	2.24	0.88	1.03	0	0.16	0.43	11.44	8.87	
	1916	2.84	0.04	1.27	2.04	0	0.45	2.73	0.87	0.31	2.77	T.	0.12	13.44	6.40	
	1917	1.02	0.62	0.38	0.10	1.20	0.00	0.70	0.41	1.34	0.00	0.08	0.00	5.85	3.75	
Average		0.49	0.35	0.43	0.95	0.89	0.62	1.70	1.48	1.10	0.96	0.62	0.34	9.93	6.74	
Av. No. days with precipitation ..		3	2	2	4	4	3	8	7	5	4	3	2	47	31	17
Av. snowfall, in..		1.7	2.2	2.8	0.6	T.	0	0	0	0	0.4	2.3	3.5	13.5		16
Temperature—																
Mean		29.7	35.0	43.2	50.5	58.4	67.7	71.8	71.1	64.4	51.9	39.3	28.4			17
Mean Max.		44.0	49.9	59.6	66.7	75.2	85.6	87.4	86 8	81.1	68.6	55.7	42.7	66.9		17
Mean Min.		15.3	20.1	26.9	34.6	41.6	49.9	56.2	55.6	47.6	35.3	23.3	14.1	35.0		17
Highest		71	67	81	86	95	101	100	101	95	88	77	68	101		20
Lowest		−23	−5	−3	10	22	33	41	42	24	17	−6	−14	−23		20
Prevailing wind..		N	N	S	S	SW	S	S	S	SSW	S	N	N	S		20
Days clear		20	17	17	17	20	22	15	17	21	23	20	20	229	112	20
Days partly cl'dy.		6	6	10	7	7	6	11	11	7	6	6	7	90	49	20
Days cloudy		5	5	4	6	4	2	5	3	2	2	4	4	46	22	20

Frost—Average date of first killing frost in autumn, Oct. 9.
Average date of last killing frost in spring, April 27.
Earliest date of killing frost in autumn, Sept. 12.
Latest date of killing frost in spring, May 31.
Average length of growing season, 165 days.
Years recorded, 20.

*Computed from nearby stations.

RIO ARRIBA COUNTY

STATION—HAYNES. APPROX. LATITUDE—36° 16′. LONGITUDE—107° 26′. ELEVATION—6,600 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Precipitation	1910	0.55	1.54	0.69	1.02	0.01	0.04	1.12	1.20	0.35	2.26	0.54	0.50	9.82	3.74	
	1911	0.29	1.41	0.50	1.41	0.26	1.33	5.64	1.29	1.80	1.48	0.44	0.22	16.07	11.73	
	1912	0.02	0.45	1.15	0.86	0.60	0.38	1.36	2.00	0	0.50	0.01	0.19	7.52	5.20	
	1913	0.15	1.00	0.50	0.13	0.04	0.81	0.04	2.70	2.34	1.40	0.95	2.03	12.09	6.06	
	1914	0.86	0.33	0.32	0.77	1.51	1.06	4.35	1.02	1.26	1.95	0	1.72	15.15	9.97	
	1915	0.42	0.22	0.24	2.55	0.61	0.20	4.40	0.88	1.83	T.	T.	0.40	11.75	10.47	
	1916	1.25	0.07	0.15	0.15	0	0	0.16	1.50	....	4.60	0.01	....	.....	.....	
	1917	0.51	0.38	0.26	0.08	1.26	0.25	1.32	1.33	0.87	0.52	0.00	0.00	6.78	5.11	
Average		0.51	0.68	0.47	0.87	0.53	0.46	2.30	1.49	1.20	1.59	0.24	0.77	11.31	6.85	
Av. No. days with precipitation ...		6	5	5	5	2	3	7	4	4	4	2	5	52	25	
Av. snowfall, in..		5.6	6.5	2.2	0.8	0.1	0	0	0	0	0.4	0.1	8.7	24.4		
Temperature—																
Mean..........		22.4	28.0	35.0	44.0	52.4	62.4	67.8	67.0	59.7	47.4	36.3	19.8	45.2		
Mean Max.		39.2	44.6	53.5	61.4	70.2	79.3	83.3	82.3	75.0	64.4	54.8	39.1	62.3		
Mean Min.		5.6	11.4	16.5	26.5	34.7	45.5	52.3	51.7	44.4	30.4	17.8	0.6	28.1		
Highest		56	68	76	78	84	96	95	96	94	81	70	58	96		
Lowest		–20	–15	–8	6	16	31	30	39	16	14	3	–21	–21		
Prevailing wind...		NW	NW	NW	NW	NW	NW	NW	NW	NW	NW	NW	NW	NW		
Days clear		21	18	19	17	20	21	15	16	21	22	24	20	234	110	
Days partly cl'dy.		4	4	8	7	8	7	12	11	5	4	2	3	75	50	
Days cloudy		6	6	4	6	3	2	4	4	4	5	4	8	56	23	

Frost—Average date of first killing frost in autumn, Sept. 22.
Average date of last killing frost in spring, May 13.
Earliest date of killing frost in autumn, Sept. 10.
Latest date of killing frost in spring, May 30.
Average length of growing season, 132 days.

This is one of the large northern border counties, with great variation in altitude and climate. Lower levels along the Rio Grande in the southeastern corner have an altitude of about 5,500 feet, and these are dry, rather hot, and successful only as irrigated or grazing lands. From this comparatively low district there rises rapidly vast mesa, plateau and mountain country, reaching an altitude of about 12,000 feet along the northeast border of the county and showing an increase in precipitation to 16, 18, 20 and even 25 inches annually, with deep snow and long winters. Much of the county, however, is below the 8,000 foot level. The winds are prevailing southwest to west, and often fresh over the open lowlands and mesas. Much bright, dry, pleasant weather obtains over the lowlands and mesas, but the uplands are more stormy, with long, cold, snowy winters, and short cool summers. The growing season, except in the lowlands, is short, with late spring frost and early autumn frost.

Average annual precipitation, 10 to 12 inches, 16, 18 to 25 inches in mountains.

Average seasonal precipitation, 6 to 9 inches, 12 to 16 inches.

Average seasonal snowfall, 10 to 20 inches; 40, 60 and 100 inches in mountains.

Mean annual temperature, 43 to 51 degrees.

Mean winter temperature, 24 to 32 degrees.

Mean summer temperature, 62 to 70 degrees.

Along the irrigated intermontane valleys in the northern part of the county, beans, short season corn, wheat, oats, barley, peas, cabbage, turnips, carrots and Irish potatoes are raised. Alfalfa is a crop that can be raised almost any place where water for irrigation can be had. In the southern part of the county in the Chama and Rio Grande Valleys, quite intensive farming is being practiced. The principal crops are alfalfa, beans, corn, wheat, oats, tomatoes, chile, and, on a smaller scale, cabbage, melons, pumpkins, sorghums, and root crops are also raised. In all of the irrigated valleys apples are found to be the most successful fruit, although the European plums and sour cherries are also raised. On the higher mesas and plateaus where there is considerable rainfall, oats, barley, wheat, peas, some beans, and Irish potatoes are raised without irrigation.

This is one of the foremost stock raising counties, on account of the fine grazing afforded by the mesas and mountains; sheep being the principal livestock.

ROOSEVELT COUNTY

STATION—PORTALES. APPROX. LATITUDE—34° 12′. LONGITUDE—103° 20′. ELEVATION—4,004 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Precipitation	1905	....	1.46	2.60	3.06	1.29	1.97	3.60	2.33	1.22	0.24	2.25	1.03	21.30	13.47	
	1906	0.56	0.54	0.77	3.89	0.74	1.33	5.20	3.07	2.73	0.39	1.81	0.75	22.47	19.06	
	1911	....	....	....	....	.....	....	....	....	....	2.06	0.59	3.77	.....	.....	
	1912	0	1.45	0.12	0.69	1.35	1.76	0.92	3.66	3.95	0.31	....	0.40	.....	12.33	
	1913	0.25	0.86	....	....	0.91	7.55	1.00	1.00	1.75	1.21	2.26	2.20	.....	.....	
	1914	T.	0.03	0.12	0.94	12.67	1.66	3.56	0.99	0.29	3.00	0.03	0.47	23.76	20.11	
	1915	0.14	1.16	1.77	6 67	1.72	1.26	4.22	2.97	5.24	0.69	0.02	0.08	25.94	22.08	
	1916	0.47	0.10	0.28	1.78	0.15	0.48	1.15	5.25	1.49	2.13	0.03	0.68	13.99	10.30	
	1917	0.54	0.08	0.02	0.21	1.19	T.	1.19	3.77	0.38	T.	0.02	T.	7.40	6.74	
Average		0.28	0.71	0.81	2.46	2.50	2.00	2.60	2.88	2.13	1.11	0.88	1.04	19.14	14.57	
Av. No. days with precipitation ...		2	3	5	6	4	5	6	7	7	5	3	3	56	35	
Av. snowfall, in..		1.5	6.1	2.9	0 4	0	0	0	0	0	0.5	1.2	4.2	16.8		
Temperature—																
Mean		38.8	39.9	46.8	55.3	65.0	73.6	76.0	74.8	68.2	56.6	46.8	37.1	56.6		8
Mean Max.		54.2	56.0	58.5	70.7	81.6	88.8	90.9	89.4	83.7	72.9	64.4	51.8	72.2		8
Mean Min.		23.3	23.8	35.1	39.9	48.4	58.3	61.1	60.3	52.7	40.2	29.2	22.4	41.6		8
Highest		76	82	86	89	98	101	103	100	98	91	85	75	103		8
Lowest		–12	–7	0	17	25	37	50	40	34	15	–3	–4	–12		8
Prevailing wind..		W	W	W	WS	SSW	SE	SE	SE	SE	E	SE	W	SE		7
Days clear		21	6	16	15	20	15	13	15	17	20	22	18	298	95	6
Days partly cl'dy..		8	9	8	9	8	13	12	12	10	6	3	7	105	64	6
Days cloudy		2	13	7	6	3	2	6	4	3	5	5	6	62	24	6

Frost—Average date of first killing frost in autumn, Oct. 15.
Average date of last killing frost in spring, April 11.
Earliest date of killing frost in autumn, Oct. 8.
Latest date of killing frost in spring, May 7.
Average length of growing season, 184 days.

This is an eastern border county in the plains region, with comparatively low altitude, averaging from 4,000 to 4,500 feet. It consists of rolling prairie land that receives from 16 to 18 inches annual precipitation and has proven suitable for dry land culture. The prevailing winds of the county are southwest to west and fresh, with much bright, warm weather and a fairly long growing season.

Average annual precipitation, 16 to 18.5 inches.
Average seasonal precipitation, 13 to 15 inches.
Averal seasonal snowfall, 12 to 17 inches.
Mean annual temperature, 54 to 57 degrees.
Mean summer temperature, 72 to 75 degrees.
Mean winter temperature, 36 to 39 degrees.

Like Curry County, this is a good dry farming county, where beans, broom corn, milo, kafir, feterita and corn are the principal crops raised. It also has an extensive shallow water area, which has been widely developed in the Portales Valley, where agriculture is largely carried on by pump irrigation. Here a large variety of crops can be raised. Beans, celery, cabbage, onions, peppers, sweet potatoes, melons, beets, corn and all of the sorghums; also fruit, such as apples, peaches, plums, sour cherries and grapes, are raised, although the fruit industry has not been very highly developed.

Much of the prairie land not used for farming affords excellent pasture for sheep and cattle. Dairying is also developing into an extensive industry.

SANDOVAL COUNTY

STATION—JEMEZ SPRINGS. APPROX. LATITUDE—35° 47'. LONGITUDE—106° 42'. ELEVATION—6,100 FT.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs
Precipitation	1910	....	....	....	....	.25	0.55	3.34	2.17	0.36	1.96	1.42	0.62	.....	.....	
	1911	0.81	2.51	0.75	0.47	0.87	1.83	4.80	1.68	2.10	5.19	2.02	0.22	23.25	11.75	
	1912	T.	0.40	2.36	1.15	0.33	3.01	3.53	2.01	0.34	1.05	T.	0.40	14.58	10.37	
	1913	0.80	1.60	0.73	1.57	0.04	3.77	0.66	2.09	1.85	0.08	2.08	1.98	17.25	9.98	
	1914	0.90	0.47	0 02	0.89	2.03	1.99	3.88	5.30	0.76	3.24	T.	2.28	21.76	14.85	
	1915	1.41	1.13	0.79	4.32	1.77	1.06	4.77	2.30	1.75	0.18	0.40	1.34	21.22	15.97	
	1916	5.12	0.54	2.12	2.15	0.37	T.	3.45	4.55	0.62	3.72	T.	0.32	22.96	11.14	
	1917	1.39	0.85	0.08	0.12	2.10	T.	2.23	0.97	1.41	0.10	T.	0.00	9.25	6.83	
Average		1.49	1.07	0.98	1.52	0.97	1.53	3.33	2.63	1.15	1.94	0.74	0.90	18.61	11.13	
Av. No. days with precipitation ..		6	5	5	7	5	6	13	12	6	5	3	5	78	49	7
Av. snowfall, in..		10.8	11.3	5.1	2.5	0.4	0	0	0	0.1	1.3	2.3	9.8	43.6		7
Temperature—																
Mean		31.2	34.6	41.6	49.2	57.1	65.6	68.7	63.2	60.6	50.6	41.0	29.6	49.4		7
Mean Max.		42.4	45.5	54.2	63.5	72.6	81.1	82.0	72.3	74.2	64.2	54.6	41.2	62.3		7
Mean Min.		20.0	23.8	28.9	35.0	41.6	50.2	55.4	54.0	46.9	36.9	27.5	17.9	36.5		7
Highest		61	62	75	79	87	95	93	91	86	82	77	66	95		7
Lowest		–13	–6	4	13	23	34	40	45	32	17	0	1	–13		7
Prevailing wind..		SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW		7
Days clear		15	15	13	11	17	13	7	9	15	20	17	13	165	72	7
Days partly cl'dy.		8	5	8	9	8	8	12	11	8	4	6	10	97	56	7
Days cloudy		8	8	10	10	6	9	12	11	7	7	7	8	103	55	7

Frost—Average date of first killing frost in autumn, Oct. 26.
Average date of last killing frost in spring, April 27.
Earliest date of killing frost in autumn, Sept. 22.
Latest date of killing frost in spring, May 20.
Average length of growing season, 182 days.

This is a north central county, mostly west of the Rio Grande, as the stream traverses the southeast corner. Great variation occurs in altitude and climate. There is much rough, mountainous country within the county, which rises in its northeast portion to 10,000 feet, and there are vast plateaus or mesas from 6,000 to 8,000 feet. The precipitation is small along the Rio Grande, averaging about 8 to 10 inches, but increasing to 14, 16, 18 and even 20 inches or more in the higher altitudes, where deep snow and long winters obtain. Winds are prevailing southwest to southeast and fresh over the lower valleys. Much sunshine occurs over the lower levels, but more cloudiness and frequent showers in summer in the higher districts. The growing season is short except in the lower valleys. The precipitation, temperature and other weather data given for Albuquerque, Bernalillo County, can be applied to the Rio Grande Valley in this county.

Average annual precipitation, 8 to 14 inches, to 16, 18 and 20 inches in mountains.

Average seasonal precipitation, 6 to 11 inches, to 14 and 16 inches in mountains.

Average seasonal snowfall, 10 to 40 inches, to 100 inches in mountains.

Mean annual temperature, 45 to 52 degrees.

Mean summer temperature, 63 to 67 degrees.

Mean winter temperature, 28 to 35 degrees.

About 40 per cent of the crops raised are grown under dry farming. Beans, short season corn, wheat, oats, barley and peas are among the principal dry farming crops. In the valleys of the Rio Grande, Jemez and Puerco Rivers the farming is done by irrigation; and alfalfa, wheat, barley, oats, corn sorghum, chile, beans, cabbage, cauliflower, beets, carrots, melons, onions, and tomatoes are among the leading crops. Among the fruits successfully raised are apples, European and native plums, cherries, gooseberries, strawberries, raspberries and grapes. Irish potatoes are also raised in the higher altitudes of 7,500 to 8,500 feet in the mountains where there is enough rainfall to insure the crop. It is not advisable to try to grow fruits without irrigation, particularly the apples, pears and peaches.

This is a good grazing county, and both sheep and cattle are prosperous industries. There are probably eight times as many sheep, however, as there are cattle on the ranges.

SAN JUAN COUNTY

STATION—BLOOMFIELD. APPROX. LATITUDE—36° 43′. LONGITUDE—108° 00′. ELEVATION—5,500 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs
Precipitation	1891	....	....	....	....	....	....	....	0.52	1.58	0	0	1.09	.....	.....	
	1892	0.35	1.31	0.85	0.12	0.45	0	0.88	T.	T.	....	T.	0.29	.....	.....	
	1893	T.	1.25	....	....	....	....	....	....	....	....	....	....	.....	.....	
	1894	0.15	0.95	....	0.03	0.15	T.	0.01	1.78	1.18	....	0	0.40	.....	3.15	
	1895	0.94	0.55	0.10	0	1.07	0.36	0.54	0.43	0.13	0.51	2.03	T.	6.66	2.53	
	1896	0.16	0.23	0.10	0.05	T.	T.	1.02	0.87	1.32	2.55	0.32	0.66	7.28	3.26	
	1897	1.21	1.30	0.94	0.23	1.56	T.	0.78	0.49	2.79	1.53	0.05	0.32	11.20	5.85	
	1898	0.67	0.14	0.73	1.31	0.90	1.19	2.47	0.89	T.	0	0.42	1.44	10.16	6.76	
	1899	0.57	0.65	0.74	0.07	0.05	0.70	1.26	3.30	0.61	0.94	0.45	0.43	9.77	5.99	
	1900	0.12	0.07	0.27	1.41	0.49	0.58	0	0.14	1.18	0.76	1.15	0.12	6.29	3.80	
	1901	1.16	....	....	....	0.79	T.	0.09	1.16	0.14	0.67	0.48	0.40	.....	.....	
	1902	0.76	0.31	....	....	0.77	0.45	0.10	0.51	....	....	....	....	.....	.....	
	1904	....	....	....	....	....	....	....	....	0.68	1.01	0	1.03	.....	.....	
	1905	0.59	1.15	1.79	3.07	0.24	1.38	0.54	0.08	0.75	0	1.84	0.03	11.46	6.06	
	1906	0.19	0.22	2.13	1.97	0.69	0.05	0.33	0.73	1.33	0.34	0.65	1.39	10.02	5.10	
	1907	0.53	0.25	0.30	1.27	0.68	0.80	1.01	1.46	0.21	0.46	0.44	0.43	7.84	5.43	
	1908	0.26	1.52	0.20	0.56	0.50	0.06	0.47	3.30	0.05	0.46	0.22	1.23	8.83	4.94	
	1909	0.76	0.42	1.21	0.54	0.33	0.22	1.71	4.44	1.25	0.18	0.36	0.67	12.09	8.49	
	1910	0.17	0.23	0.18	0.53	T.	0.07	1.56	0.55	0.86	1.03	0.73	1.85	6.76	3.57	
	1911	0.47	2.33	0.80	0.87	0.02	0.25	4.01	1.06	1.13	2.35	0.41	0.26	13.96	7.34	
	1912	0.03	0.26	1.05	0.57	T.	0.92	0.67	1.21	0.08	1.45	0.25	0.33	6.82	3.45	
	1913	0.10	0.81	0.80	0.29	0.19	0.46	0.44	0.82	1.58	1.42	1.30	1.03	9.24	3.78	
	1914	0.87	0.55	0.40	0.62	0.78	0.72	4.07	2.08	0.40	1.98	0.01	0.79	13.27	8.68	
	1915	0.75	0.78	0.47	2.43	0.78	0.04	1.27	0.55	1.62	0	0.23	0.68	9.60	6.69	
	1916	1.82	0.40	1.40	0.37	0.22	0.12	2.01	0.48	0.52	2.24	0.01	0.36	9.95	3.72	
	1917	0.64	0.12	0.02	0.58	0.84	0.90	0.86	0.58	0.33	0.04	0.00	0.00	4.91	4.09	
Mean		0.55	0.69	0.72	0.80	0.55	0.40	1.14	1.18	0.82	0.91	0.47	0.59	8.82	4.89	
Av. No. days with precipitation ...		6	7	6	8	3	2	8	8	4	5	4	6	67	33	12
Av. snowfall, in...		3.5	4.5	2.4	0.5	0.1	0	0	0	T.	1.6	1.0	4.2	17.8		21
Temperature—																
Mean		28.1	33.5	42.3	50.2	57.9	67.5	74.0	72.6	64.1	51.5	39.4	27.3	50.7		22
Mean Max.		42.8	49.2	60.3	68.4	76.7	86.9	91.3	89.0	81.3	68.8	57.0	41.9	67.8		12
Mean Min.		16.8	21.2	26.7	33.4	38.2	46.5	56.3	55.4	45.4	33.8	22.1	13.4	34.1		12
Highest		68	66	89	90	100	102	106	104	96	89	77	66	106		22
Lowest		−16	−23	3	9	18	29	38	36	21	10	−2	−18	−23		22

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Prevailing wind..		SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW		12
Days clear		12	11	11	11	14	17	7	7	14	18	17	12	151	70	
Days partly cl'dy.		12	13	17	17	16	12	23	23	14	11	10	13	181	105	
Days cloudy		7	4	3	2	1	1	1	1	2	2	3	6	33	8	

Frost—Average date of first killing frost in autumn, Sept. 28.
Average date of last killing frost in spring, May 20.
Earliest date of killing frost in autumn, Sept. 12.
Latest date of killing frost in spring, June 14.
Average length of growing season, 131 days.
Years recorded, 14.

SAN JUAN COUNTY

STATION—FRUITLAND. APPROX. LATITUDE—36° 43′. LONGITUDE—108° 28′. ELEVATION—4,800 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs
Precipitation	1891	....	....	....	T.	0.83	0.15	0.64	0.14	2.26	0	0	1.57	.....	4.02	
	1892	1.20	1.86	0.15	0.37	0.53	0	0 84	0.14	0	0.87	0	T.	5.96	1.88	
	1893	0.05	0.85	0.43	T.	0.76	0	1.15	0.52	1.36	0	T.	T.	5.12	3.79	
	1894	0	0.78	0.47	0.19	0 45	0	0.22	....	0.54	0.56	0	....	.....	.....	
	1895	....	0.65	T.	0	0.51	0.60	0	0.16	T.	....	0.51	T.	.....	1.27	
	1896	....	....	....	T.	....	....	0.73	....	....	....	....	T.	.....	.....	
	1897	....	....	T.	T.	1.59	0	0.39	T.	2.15	....	....	0	.....	4.13	
	1898	....	....	....	....	....	0.05	....	....	....	....	....	....	.....	.....	
	1899	....	0.20	....	T.	0	T.	....	....	....	....	....	....	.....	.....	
	1900	....	....	....	....	T.	T.	....	....	0.63	T.	....	....	.....	.....	
	1901	....	0.75	T.	....	T.	T.	T.	0.65	T.	....	....	....	.....	.....	
	1902	....	T.	T.	0	0.31	T.	T.	0.31	....	....	....	0.12	.....	.....	
	1903	0.09	0.75	0.10	....	0.03	....	0.09	....	....	0	0	T.	.....	.....	
	1904	0.12	T.	0.07	T.	1.10	T.	0.03	0.06	0.13	1.16	0	0.26	3.33	1.72	
	1905	0.56	1.15	0.64	2.39	T.	0.95	1.26	0.09	0.23	T.	1.75	0.15	9.17	4 92	
	1906	T.	0.30	1.91	1.43	0.06	0	1.05	0.81	1.47	0.13	1.18	1.31	9.66	4.83	
	1907	0.12	0.22	0.14	0.70	0.55	0.52	1.52	2.26	0.20	1.30	0.20	0.44	8.17	5.75	
	1908	0.32	1.57	0.01	0.37	0.36	T.	1.44	1 06	T.	0.03	T.	0.85	6.01	3.23	
	1909	0.31	0.42	0.57	0.40	T.	T.	0.31	2.25	0.95	0.02	0.05	0.94	6.22	3.91	
	1910	0.29	0.22	0.05	1.04	0	0.25	0.90	0.48	0 42	1.45	0.67	0.32	6.09	3.09	
	1911	0.48	1.44	0.69	0.50	T.	0.37	4.50	0.54	2.88	1.50	0.25	0.17	13.32	8.79	
	1912	0	0.13	1.07	0.52	T.	0.32	2.29	0.60	0 01	1.55	T.	0.12	6.61	3.74	
	1913	T.	0.87	0.99	T.	0	T.	1.57	0.51	1.42	1.87	1.87	1.20	10.30	3.50	
	1914	1.04	0.30	T.	0.15	0.97	0.25	1.49	1.82	T.	1.74	0	0.42	8.18	4.68	
	1915	0.91	0.53	0.08	1.64	0.18	T.	0.81	T.	0.70	0	0.55	0.47	5.87	3.33	
	1916	1.60	0.37	0.53	0.27	0	T.	1.62	0.12	T.	1.86	0.15	0.03	6.55	2.01	
	1917	0.68	0.15	T.	T.	0.45	0.00	0.30	T.	0.62	0.00	T.	0.00	2.20	1.37	
Average		0.43	0.61	0.36	0.43	0.25	0.14	0.96	0.60	0.74	0.70	0.36	0.34	5.92	3.12	
Av. No. days with precipitation ...		2	4	3	2	1	1	4	3	2	3	2	3	30	13	24
Av. snowfall, in..		1.9	2.8	0.9	T.	0.1	0	0	0	0	T.	0.4	2.4	8.5		19

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs
Temperature—																
Mean		29.9	35.0	43.6	51.6	59.6	68.0	74.0	72.7	63.6	51.3	39.9	29.0	51.5		20
Mean Max.		43.9	49.7	60.0	69.6	78.3	89.1	91.9	89.5	81.2	69.0	55.4	43.9	68.5		20
Mean Min.		17.3	19.8	27.3	34.3	40 8	47.3	54.9	55.9	45.8	33.7	23.6	14.8	34.6		20
Highest		71	86	83	92	97	108	110	109	95	90	90	79	110		20
Lowest		–10	–14	6	8	13	31	34	39	24	11	–1	–17	–17		20
Prevailing wind..		W	W	W	W	W	W	W	WSW	W	W	W	W	W		24
Days clear		17	15	19	20	20	21	15	16	18	23	21	21	226	110	24
Days partly cl'dy.		7	7	8	7	9	8	14	14	10	6	6	7	103	62	24
Days cloudy		7	6	4	3	2	1	2	1	2	2	3	3	36	11	24

Frost—Average date of first killing frost in autumn, Oct. 5
Average date of last killing frost in spring, May 7.
Earliest date of killing frost in autumn, Sept. 17.
Latest date of killing frost in spring, June 5.
Average length of growing season, 151 days.
Years recorded, 22.

This is a northwest border county, with comparatively low altitude (4,500 to 5,500 feet), except in the northeast, the southeast and the southwest portions, where foothills and mountains 6,000 to 8,000 feet obtain. The lower levels of the county are very dry, probably the driest portions of the state, and the increase of precipitation with altitude is not large. However, the county is traversed by the San Juan River and several of its tributaries, affording irrigation water for a large amount of land, susceptible of easy irrigation and much of which is already under cultivation. The prevailing wind direction over the county is from the southwest and west. Much sunshine, warmth and a fairly long growing season are characteristics.

Average annual precipitation, 5 to 10 inches.
Average seasonal precipitation, 3 to 7 inches.
Average seasonal snowfall, 5 to 15 inches.
Mean annual temperature, 50 to 52 degrees.
Mean summer temperature, 70 to 72 degrees.
Mean winter temperature, 30 to 32 degrees.

There is considerable farming being carried on by irrigation, particularly in the San Juan, Las Animas and La Plata river valleys. In these irrigated basins beans, peas, tomatoes, squash, pumpkins, sweet corn, onions, cabbage, beets, turnips, corn, alfalfa, wheat, barley and oats are among the principal crops grown. While as a rule the Irish potato is not dependable in altitudes lower than 7,500 feet, in the valleys in San Juan County they are being grown quite successfully. Fruit growing, largely the growing of apples, has been one of the principal industries. Peaches, European and native plums, cherries, pears, and grapes are also well suited to the valley conditions.

On the whole, there is not enough rainfall for dry farming in the lower and central part of the county. Even on the higher mesas there is hardly enough to insure the successful growth of crops every year. The soil and climatic conditions in the prairie and mesa districts are favorable, however, for the growth of the same crops that are grown in the valleys, if enough moisture could be had. Again the question of sufficient moisture is to a large degree the limiting factor, and reduces the number of varieties of crops that can be grown. Beans are one of

the most drouth-resistant plants, and if any crop will grow with a limited amount of rainfall it is this. Up near the headwaters of the larger canyons or around the edge of the basin some dry farmers are doing well; but taken as a whole the county is better adapted to irrigated farming, with surrounding ranges for stock.

The grazing of livestock is an important business, and there are probably ten times as many sheep as cattle.

SAN MIGUEL COUNTY

STATION—BELL RANCH. APPROX. LATITUDE—35° 36′. LONGITUDE—104° 07′. ELEVATION—4,500 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Precipitation	1899	....	....	....	....	....	1.53	3.81	0.11	2.54	0.20	1.20	1.80	.....	.....	
	1900	0.65	0.78	0.85	2.89	4.35	1.38	2.43	4.23	1.97	1.17	0.37	0.30	21.37	17.25	
	1901	0.48	0.81	0.40	1.68	3.99	0.40	4.83	1.65	0.86	0.78	2.61	T.	18.49	13.41	
	1902	0.22	T.	0.10	0.18	1.14	1.72	1.34	2.38	0.20	0.36	0.54	0.53	8.71	6.96	
	1903	T.	1.45	0.36	0.74	1.33	5.09	0.73	2.15	0.89	1.13	T.	0.00	13.87	10.93	
	1904	T.	0.10	0.07	0.28	1.02	4.04	2.68	2.81	4.04	0.69	T.	0.61	16.34	14.87	
	1905	0.50	1.15	2.07	4.15	1.60	0.43	3.06	1.44	1.51	0.06	5.24	0.78	21.99	12.19	
	1906	0.25	0.51	T.	2.66	0.46	0.62	3.16	0.34	2.77	1.19	1.00	0.53	13.49	10.01	
	1907	0.73	0.00	0.00	2.66	2.42	2.59	2.60	3.16	0.17	0.82	T.	0.60	15.75	13.60	
	1908	0.40	0.58	0 00	1.05	0.34	1.31	2.98	2.19	0.45	0.65	1.25	T.	11.20	8.32	
	1909	T.	0.16	0.72	0.34	2.44	1.64	4.01	0.99	3.20	1.93	0.51	0.15	16.09	12.62	
	1910	0.03	0.14	0.33	0.13	0.18	2.30	2.78	2.69	0.17	0.44	0.26	0.03	9.48	8.25	
	1911	0.13	1.37	T.	1.47	4.86	0.59	5.34	1.43	1.72	1.18	0.30	0.65	19.04	15.41	
	1912	T.	1.10	0.37	0.82	2.01	1.85	2.23	3.50	1.79	0.11	0.00	0.25	14.03	12.20	
	1913	0.31	0.13	0.20	3.80	0.53	4.00	1.41	1.91	1.47	0.23	1.20	2.13	17.32	13.12	
	1914	0.00	0.20	0.18	3.12	5.67	2.59	5.40	0.48	T.	2.68	0.00	0.81	21.13	17.26	
	1915	0.27	0.79	1.20	7.21	1.09	0.77	2.56	2.41	1.94	0.73	T.	0.17	19.14	15.98	
	1916	0.59	T.	0.32	1.69	0.05	0.66	1.70	5.68	0.58	1.12	0.09	0.23	12.71	10.36	
	1917	0.44	0.14	0.07	0.32	1.57	0.74	1.04	2.04	0.91	0.10	0.40	T.	7.77	6.62	
Mean		0.28	0.52	0.40	1.96	1.95	1.80	2.85	2.19	1.43	0.82	0.79	0.50	15.49	12.18	
Av. No. days with precipitation ..		1	2	2	5	6	5	9	7	5	3	2	2	49	37	17
Av. snowfall, in..		1.6	3.7	1.6	2.0	0	0	0	0	T.	0.7	2.4	3.7	15.7		12
Temperature—																
Mean		38.3	38.9	48.0	55.2	63.6	73.5	76.8	76.3	69.1	55.9	45.5	35.7	56.4		11
Mean Max.		56.8	55.8	66.2	72.5	80.3	89.6	91.2	91.3	85.1	72 3	62.6	51.8	73.0		11
Mean Min.		19.8	21.9	29.9	37.9	46.8	57.3	62.3	61.2	53.1	39.5	28.4	19 6	39.8		11
Highest		78	76	92	94	97	104	106	103	98	91	85	79	106		11
Lowest		–20	–18	–3	15	21	40	46	39	31	15	3	–10	–20		11
Prevailing wind..		W	W	W	W	SW	SW	SW	SW	SW	SW	SW	W	SW		11
Days clear		19	16	17	16	14	14	13	16	17	21	20	19	202	90	17
Days partly cl'dy.		8	7	10	10	14	14	15	13	10	7	7	9	124	76	17
Days cloudy		4	5	4	4	3	2	3	2	3	3	3	3	39	17	17

Frost—Average date of first killing frost in autumn, Oct. 19.
Average date of last killing frost in spring, April 19.
Earliest date of killing frost in autumn, Sept. 28.
Latest date of killing frost in spring, May 7.
Average length of growing season, 182 days.

SAN MIGUEL COUNTY

STATION—LAS VEGAS. APPROX. LATITUDE—35° 36′. LONGITUDE—105° 14′. ELEVATION—6,384 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Precipitation	1850	....	....	....	0.02	....	....	....	....	0.00	0.00	0.12	3.12	......	.....	
	1851	....	4.23	0.01	2.11	2.82	0.00	5.10	....	....	....	....	.....	......	.....	
	1875	....	....	2.40	0.25	1.30	0.85	8.15	2.75	8.10	0.00	0.65	0.20	......	21.40	
	1876	0.40	....	....	....	....	....	....	....	....	....	....	.....	......	.....	
	1887	....	....	....	....	....	....	....	....	2.25	3.05	1.88	0.11	......	.....	
	1888	0.14	0.76	0.55	0.76	3.00	1.68	3.54	5.85	....	0.40	1.08	0.45	......	.....	
	1889	1.19	0.23	0.50	2.15	0.35	1.25	4.30	1.15	0.80	1.30	4.20	1.01	18.42	10.00	
	1890	....	1.50	....	....	3.20	....	....	....	....	....	....	.....	......	.....	
	1892	1.22	0.07	1.72	0.41	0.54	1.01	2.28	0.79	0.48	1.31	0.05	*0.43	*10.31	5.51	
	1893	0.18	1.16	0.07	0.00	1.50	0.25	5.64	6.97	3.87	0.04	0.00	0.31	19.99	18.23	
	1894	0.10	1.66	0.04	0.54	2.53	2.82	2.89	4.05	1.22	0.08	0.00	0.28	16.21	14.05	
	1895	1.00	1.85	0.30	0.52	4.02	1.98	6.84	5.32	T.	1.12	0.88	0.82	24.65	18.68	
	1896	0.19	0.32	0.83	1.00	0.11	2.02	3.87	2.13	4.38	4.35	0.02	0.51	18.73	13.42	
	1897	0.69	0.70	1.43	0.37	6.63	1.23	1.18	3.29	0.79	1.94	0.00	0.59	18.84	13.49	
	1898	0.51	0.21	0.49	1.41	1.04	2.74	4.63	2.97	1.29	0.33	0.57	0.80	16.99	14.08	
	1899	T.	0.73	0.70	0.21	0.40	2.65	7.09	0.17	2.87	0.52	0.43	0.09	15.86	13.39	
	1900	0.19	0.25	0.59	2.25	1.87	3.59	2.70	2.23	4.27	1.98	0.30	0.46	20.68	16.91	
	1901	0.27	0.70	0.14	1.17	5.55	0.19	3.70	4.95	2.00	1.40	1.78	0.30	22.15	17.56	
	1902	0.10	0.10	0.01	0.06	1.95	0.30	1.91	1.83	1.33	0.47	0.79	0.93	9.78	7.38	
	1903	0.07	1.42	0.13	0.52	0.22	6.24	1.41	3.57	1.11	0.00	T.	0.12	14.81	13.07	
	1904	0.20	0.20	T.	0.24	0.97	3.20	4.95	0.68	6.07	1.08	0.05	1.10	18.74	16.11	
	1905	1.45	1.84	2.13	3.07	2.04	1.56	1.70	1.34	4.25	0.48	3.32	0.68	23.86	13.96	
	1906	0.04	1.02	0.47	2.17	1.08	2.80	7.82	1.97	1.86	1.67	0.86	1.32	23.08	17.70	
	1907	1.57	0.01	0.07	2.13	2.57	0.77	5.57	3.30	0.22	0.82	0.77	0.20	18.00	14.56	
	1908	0.14	1.05	0.05	1.12	0.68	1.13	2.71	9.24	0.06	0.76	0.96	0.26	18.16	14.94	
	1909	0.17	0.49	1.00	0.50	0.51	0.51	0.53	5.99	3.91	0.76	0.19	0.44	16.00	12.95	
	1910	0.16	0.30	0.61	0.98	0.13	0.31	2.48	3.72	1.08	0.85	0.45	*0.34	*11.41	8.70	
	1911	0.11	1.33	0.18	0.93	2.41	2.44	3.55	2.30	0.68	2.83	0.30	0.93	17.99	12.31	
	1912	0.02	2.07	0.63	0.70	1.87	3.85	3.19	4.20	2.50	0.49	T.	0.18	19.70	16.31	
	1913	0.48	0.83	0.32	1.04	0.44	4.65	0.47	1.33	3.09	0.00	0.63	0.98	14.26	11.02	
	1914	T.	0.13	0.36	1.32	3.21	1.89	7.66	2.24	0.37	2.34	0.00	1.24	20.76	16.69	
	1915	0.57	0.84	1.21	3.59	0.71	0.34	3.61	4.41	1.14	0.76	0.28	0.40	17.86	13.80	
	1916	1.27	T.	1.35	2.86	0.19	0.41	2.98	2.61	1.42	3.09	0.07	0.21	16.46	10.47	
	1917	0.64	0.84	0.13	0.41	1.20	0.38	2.10	1.57	0.85	0.05	0.36	0.00	8.53	6.51	
Mean		0.45	0.89	0.61	1.12	1.78	1.77	3.85	3.20	2.08	1.11	0.68	0.61	18.15	13.80	

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Av. No. days with precipitation ..		2	4	3	5	6	8	12	11	6	4	2	3	66	48	23
Av. snowfall, in..		3.1	8.3	3.4	2.8	0.4	0	0	0	0.4	1.5	2.5	6.0	28.4		22
Temperature—																
Mean		33.4	34.1	41.3	49.3	57.1	65.4	68.9	67.6	60.6	49.7	40.5	32.2	50.0		29
Mean Max.		48.6	49.1	56.5	64.2	72.2	81.6	83.2	82.1	75.7	65.2	56.7	46.5	65.1		22
Mean Min.		19.3	20.1	26.9	33.5	41.5	49.2	54.1	52.9	45.5	34.6	25.0	17.1	35.0		22
Highest		72	71	82	83	95	99	99	97	93	85	78	70	99		22
Lowest		–20	–31	–11	6	21	32	40	42	20	3	–1	–15	–31		22
Prevailing wind..		W	SW	W	W	SW	SW	SW	SW	SW	SW	SW	SW	SW		23
Days clear		24	19	22	21	20	20	16	17	21	23	22	23	248	115	22
Days partly cl'dy.		5	6	6	6	8	8	12	12	7	5	5	5	85	53	22
Days cloudy		2	3	3	3	3	2	3	2	2	3	3	3	32	15	22
Mean Rel. Humid..		45	44	40	42	44	45	56	58	52	49	47	48	48		

Frost—Average date of first killing frost in autumn, Oct. 5.
Average date of last killing frost in spring, May 5.
Earliest date of killing frost in autumn, Sept. 13.
Latest date of killing frost in spring, May 26.
Average length of growing season, 153 days.
Years recorded, 23.

*Computed from nearby stations.

This is one of the very large northeast counties, with great variation in altitude, ranging from about 4,500 feet in the southeast corner along the Canadian River to about 13,000 feet over the peaks of the main range in the northwest corner. Much of the county is rolling, somewhat broken mesa lands from 5,000 to 6,500 feet in altitude; and is well adapted to dry land culture. The normal precipitation of the western part ranges from 18 to 25 inches, according to altitude, decreasing somewhat over the lower lands to the eastward, but remaining well above 15 inches in the east and south and giving promise of extensive dry land culture and stock raising. The prevailing winds are from the southwest, and fresh, over the central and eastern mesa lands, with much clear, bright weather.

Average annual precipitation, 15.5 to 18 inches, to 25 inches in mountains.

Average seasonal precipitation, 12.2 to 14 inches, to 16 or 18 inches in mountains.

Average seasonal snowfall, 15 to 28 inches, to 50 and 75 inches in mountains.

Mean annual temperature, 50 to 56 degrees.

Mean summer temperature, 67 to 76 degrees.

Mean winter temperature, 33 to 38 degrees.

Mean relative humidity, 48 per cent.

The farming is done under irrigation and dry land methods. Wherever water for irrigation can be had, excellent crops of the different kinds of small grains, alfalfa, and vegetables can be grown. Because of the high altitude in most of the irrigated districts the number of varieties of the different crops is materially reduced. Most of the irrigation farming is being carried on in the small intermontane valleys, while a considerable area is irrigated along the Pecos and Gallinas Rivers in the western part of the county, as well as along the Mora and Canadian Rivers in the northern and eastern portions, respectively. Wheat, oats, barley, peas, cabbage, celery, turnips, beans, carrots, beets, onions, alfalfa, and some short season corn are the principal crops. Chile and tomatoes mature in the lower part of the valleys, and up to 6,300 feet. Under dry farming the New Mexico Pinto bean is probably the leading

cash crop at the present time, although corn, cane, some kafir, milo and feterita, as well as Sudan grass, are grown. Considerable wheat, both winter and spring, is successfully grown under dry farming. Very little fruit is grown in this county, although in the irrigated mountain valleys apples, pears, sour cherries, peaches, and native and European plums do fairly well. Melons, squash and pumpkins can also be raised under dry farming methods. The Irish potato is not dependable in the lower sections, though at 7,500 feet and above they are being grown successfully.

Cattle and sheep grazing are flourishing industries.

SANTA FE COUNTY

STATION—SANTA FE. APPROX. LATITUDE—35° 41′. LONGITUDE—105° 57′. ELEVATION—7,013 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Precipitation	1850	....	1.26	1.00	0.65	.....	....	0.98	0.92	....	0.38	....	1.60	......	.....	
	1852	....	....	....	.....	.....	....	....	....	0.91	2.55	1.65	1.36	......	.....	
	1853	0	0.69	0.50	0	0.98	1.88	7.45	5.42	2.68	0.97	0.43	0.77	21.77	18.41	
	1854	0.36	0.12	0.01	1.68	1.16	0.32	4.11	3.86	4.06	2.50	3.54	1.08	24.80	15.19	
	1855	0.57	0.20	0.20	0.85	0.68	1.77	2.09	7.89	5.38	0	2.69	1.86	24.18	18.66	
	1856	1.29	1.36	2.59	0.88	0.48	2.32	0.78	7.08	2.52	0.99	2.18	0.60	23.07	14.06	
	1857	1.03	0.87	0.11	0.73	0.18	0.22	0.44	1.75	1.28	1.40	0.27	0.24	8.52	4.60	
	1858	0	0.48	0.69	1.05	0.58	0.73	4.04	2.40	0.43	0.03	0.30	0.62	11.35	9.23	
	1859	0.01	0.64	0.50	0.08	0	0.97	2.02	2.44	1.98	0.55	0.23	0.07	9.49	7.49	
	1860	0.43	0.69	0.35	1.18	0	1.65	1.30	0.49	2.17	0.22	0	0.35	8.83	6.79	
	1861	0.69	4.40	0.44	*0.77	*0.78	3.50	1.62	3.08	0	0.44	0	0.09	*15.81	9.75	
	1863	0.49	0.14	0	0.69	1.09	1.18	1.22	0.77	0.72	0.17	0.66	0.62	7.75	5.67	
	1864	0.21	....	0.09	.....	2.00	3.03	4.21	....	3.18	3.00	0.80	1.80	......	.....	
	1865	0.58	5.20	1.16	1.08	0.73	1.02	5.70	3.32	0.30	3.21	0	0.85	23.15	12.15	
	1866	....	0.80	....	.....	.....	....	....	....	....	....	....	.....	......	.....	
	1867	....	....	....	.....	.....	....	....	....	0	....	0.02	0.40	......	.....	
	1868	1.04	0.07	0.60	0.94	1.10	0.06	3.20	0.55	0.18	0.03	0.62	0.53	8.92	6.03	
	1869	1.71	1.01	0.88	0.70	1.46	1.55	0.55	1.47	0.20	0	1.10	1.45	12.08	5.93	
	1870	0.05	0.35	0.65	0.42	0.04	0.51	4.00	3.32	2.67	1.14	0.17	0.61	13.93	10.96	
	1871	0.49	0.20	0.51	0.38	0.85	1.26	0.91	2.89	2.89	0.77	0	0	12.15	9.18	
	1872	0.34	0.20	0.13	0.14	0.45	2.44	2.62	2.98	0.27	0.25	0.01	0.04	9.87	8.90	
	1873	0.55	0.40	0.15	0.26	0.33	1.72	1.02	2.79	1.23	0.07	0.38	0.83	9.73	7.35	
	1874	1.39	1.60	1.51	1.71	0.70	0.54	3.92	1.73	1.52	2.47	0.58	2.26	19.93	10.12	
	1875	0.67	0.72	1.37	0.33	0.88	0.33	6.91	1.59	4.14	0.06	1.50	0.47	18.97	14.18	
	1876	0.61	0.40	0.64	0.46	0.83	1.62	5.43	2.13	0.85	0.75	0.97	0.38	15.07	11.32	
	1877	0.18	1.08	0.14	1.83	0.92	0.13	3.54	1.72	0.96	1.32	0.70	0.63	13.15	9.10	
	1878	0.21	0.89	0.73	0.22	1.01	3.18	3.20	5.15	1.03	0	3.15	0.78	19.55	13.79	
	1879	0.77	0.23	0.15	0.48	0.37	0.51	2.34	2.30	1.07	1.38	1.34	0.50	11.44	7.07	
	1880	0.28	0.94	0.15	0.05	0.52	0.65	2.69	1.79	1.13	0.75	0.28	0.66	9.89	6.83	
	1881	0.38	0.22	0.57	0.98	2.31	0.08	4.72	6.28	0.91	4.19	1.11	*0.50	*22.25	15.28	
	1882	0.47	0.06	0.23	0.26	1.06	1.36	1.17	4.69	0.62	T.	0.90	0.55	11.37	9.16	
	1883	0.42	0.96	0.40	0.11	0.87	....	....	....	....	....	....	.....	......	.....	
	1884	....	....	....	.....	.....	....	....	....	....	....	....	1.77	......	.....	
	1885	0.26	0.53	1.51	1.38	1.31	1.57	1.13	0.98	0.87	1.07	1.01	2.27	14.89	9.24	

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
	1886	0.70	0.85	0.47	1.33	0.21	0.95	1.54	4.15	4.02	1.06	0.30	0.32	15.90	12.20	
	1887	0.10	0.85	0.66	0.74	1.73	0.60	2.24	1.57	2.41	1.50	0.66	0.32	13.38	9.29	
	1888	0.44	0.90	0.61	1.42	0.70	0.16	1.98	2.08	0.38	1.40	1.30	0.66	12.03	6.72	
	1889	0.84	0.53	0.80	0.44	0.15	0.63	1.32	1.43	0.67	0.37	0.45	0.26	7.89	4.64	
	1890	0.42	0.88	0.69	2.08	T.	0.13	2.46	1.49	0.89	0.93	1.31	1.60	12.88	7.05	
	1891	1.32	1.91	0.59	0.17	3.21	1.26	0.84	1.02	4.69	0.12	0.13	1.53	16.79	11.19	
	1892	1.34	1.22	1.51	0.69	0.50	1.05	2.12	0.81	T.	1.32	0.36	0.70	11.62	5.17	
	1893	0.26	0.76	0.78	0.01	0.98	0.02	3.01	5.12	3.00	0.22	0.29	0.49	14.94	12.14	
	1894	0.23	1.11	0.41	1.48	1.99	0.77	2.17	1.95	0.87	1.05	T.	1.28	13.31	9.23	
	1895	1.51	1.20	0.51	0.01	3.46	0.99	4.78	3.64	0.09	1.75	1.18	0.09	20.24	12.97	
	1896	0.36	0 57	0.53	1.11	0.27	0.69	3.78	1.47	1.39	3.19	0.25	0.67	14.28	8.71	
	1897	1.11	1.10	2.06	0.87	4.35	0.57	2.85	2.33	2.49	1.95	0.08	0.64	20.40	13.46	
	1898	0.97	0.30	0.88	1.37	0.22	1.53	2.31	4.00	0.18	0.54	0.27	0.40	12.97	9.61	
	1899	0.19	0 73	0.35	0.25	0.01	1.22	4.71	0.36	1.39	0.27	0.44	0.13	10.05	7.94	
	1900	0.38	1.00	0.63	2.10	1.65	1.44	2.85	0.83	3.00	1.19	0.74	0.08	15.89	11.87	
	1901	1.30	1.30	0.89	1.02	2.12	0.29	3.37	3.04	2.00	1.15	0.73	0.20	17.41	11.84	
	1902	0.28	0.43	1.13	0.02	2.84	0.34	1.50	2.47	2.05	0.59	0.93	0.78	13.36	9.22	
	1903	0.11	1 31	1.32	0.67	0.17	3.87	0.56	1.18	0.55	0.02	0	0.03	9.79	7.00	
	1904	0.20	0.26	0.32	0.05	0.79	1.53	0.66	2.31	5.37	1.70	0.23	0.77	14.19	10.71	
	1905	1.28	1.60	1.56	2.09	0.22	1.55	1.98	0.75	1.49	1.02	3.39	0.29	17.22	8.08	
	1906	0.35	0.55	1.05	2.23	0.45	0.51	3.82	1.84	1.71	1.63	0.68	1.78	16.60	10.56	
	1907	2.18	0 39	0.29	2.04	1.92	1.14	1.46	3.16	0.69	1.12	0.36	0.40	15.15	10.41	
	1908	0.36	0.85	0.28	1.85	2.10	0.60	2.14	2.74	0.07	1.56	1.14	0.10	12.79	9.50	
	1909	0.79	0.56	0.73	0.30	0 38	0.20	2.39	2.02	2.70	0.62	1.02	0.55	12.26	7.99	
	1910	0.76	0.08	0.55	0.99	0.30	0.56	0.82	1.91	1.12	0.40	0.86	0.30	8.65	5.70	
	1911	0.45	1.99	0.67	0.48	1.00	0.66	5.50	0.51	1.17	3.13	1.34	0.22	17.12	9.32	
	1912	0.03	0.40	1.85	0.43	0.99	2.21	1.49	1.15	0.08	0.84	0.03	0.79	10.29	6.35	
	1913	0.57	1.15	0.87	1.32	0.17	4.26	1.12	1.07	1.54	0.42	1.75	0.77	15.01	9.48	
	1914	0.19	0.63	0.82	0.44	2.28	1.72	3.98	2.51	0.59	2.40	T.	1.70	17.26	11.52	
	1915	1.95	0.77	0.70	4.82	0.83	0.16	4.37	1.02	1.62	0.04	0.61	0.97	17.86	12.82	
	1916	3.02	0.20	1.36	2.50	0.07	0.38	2.77	1.67	1.45	2.76	0.06	0.17	16.41	8.84	
	1917	0.55	0.23	0.27	0.15	0.84	0.06	0.45	1.37	0.64	0.19	0.26	0.02	5.03	3.16	
Mean		0.66	0.87	0.75	0.93	1.00	1.16	2.67	2.43	1.57	1.08	0.78	0.74	14.64	9.78	
Av. No. days with precipitation ...		6	7	6	6	7	6	14	13	8	5	5	6	89	54	43
Av. snowfall, in..		5.7	6.8	4.5	3.3	0.3	0	0	0	T.	0.9	3.7	5.5	30.7		31
Temperature—																
Mean		28.4	32.3	39.8	47.1	55.9	64.4	68.4	67.1	60.6	49.8	37.1	30.0	48.4		43
Mean Max.		39.5	43.1	51.5	58.3	68.2	78.0	79.6	79.0	72.8	61.9	49.9	40.5	60.2		43

SANTA FE COUNTY, (Continued)

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Mean Min.		18.8	22.1	28.3	34.9	42.5	51.8	57.7	56.0	48.9	38.3	27.7	20.1	37.1		43
Highest		76	75	82	84	86	92	96	97	90	85	77	65	97		43
Lowest		–13	–11	0	11	20	33	43	40	21	13	–11	–13	–13		43
Prevailing wind..		NE	NE	SW	SW	NE	SE	NE	NE	SW	NE	NE	NE	NE		
Av. hourly veloc..		7	8	8	9	8	8	7	6	6	7	7	7	7		
Days clear		18	14	15	15	15	17	10	11	17	20	19	18	190	85	
Days partly cl'dy.		9	9	12	12	13	11	17	17	10	8	8	9	133	80	
Days cloudy		4	5	4	3	3	2	4	3	3	3	3	4	42	18	
Mean Rel. Humid. 6:00 a. m.		63	64	57	51	48	46	60	63	61	59	57	63	58		
Mean Rel. Humid. 6:00 p. m........		52	49	35	28	26	25	38	39	37	40	47	54	40		
Sunshine percentage		74	72	73	77	75	81	69	71	79	81	78	78	76		

Frost—Average date of first killing frost in autumn, Oct. 18.
Average date of last killing frost in spring, April 25.
Earliest date of killing frost in autumn, Sept. 25.
Latest date of killing frost in spring, May 18.
Average length of growing season, 176 days.
Years recorded, 43.

*Computed from nearby stations.

This is a north central county, with much upland, rolling prairie and mountainous areas, traversed across its northwest corner by the Rio Grande. Large areas of the county, however, are upland grazing and dry farming districts. Altitudes vary from about 5,500 feet along the Rio Grande to 12,600 feet over the crest of the range in the northeast corner; and precipitation from 10 inches along the Rio Grande to 14.5 at 7,000 feet, and increasing to 18, 20 and 25 inches with altitude in the mountains. There is much bright, sunshiny, dry weather, with fairly long growing season; winds prevailing southwest to northeast.

Average annual precipitation, 14 to 20 inches.

Average seasonal precipitation, 10 to 15 inches.

Average seasonal snowfall, 15 to 30 inches, to 50 or more in mountains.

Mean annual temperature, 44 to 48 degrees.

Mean summer temperature, 62 to 67 degrees.

Mean winter temperature, 28 to 31 degrees.

Average hourly wind velocity, 7 miles.

Average sunshine, 76 per cent of the possible.

Average relative humidity, 49%.

Farming is done both under irrigation and dry farming methods. Most of the irrigation farming is to be found in the Rio Grande Valley, from Santa Cruz southward to San Ildefonzo, and along the smaller streams leading down from the mountains. In the irrigated districts, particularly in the Rio Grande Valley, a great many varieties of crops can be raised, such as watermelons, tomatoes, chile, beans, garden peas, onions, squash, pumpkins, cabbage, beets, cauliflower, turnips, carrots, celery, wheat and corn. Alfalfa is the principal forage crop, although the sorghums can be grown for feed. There are also apples, peaches, sour cherries and European and native plums raised successfully. The late spring frosts occasionally injure the fruit crop. In the higher intermontane valleys, particularly in the Tesuque Valley, many of the cool season crops are successfully grown, and the apple is the principal fruit crop. The soil and climatic conditions are well suited to the growing of some of the orchard fruits, but great care should be taken in the selection of the proper varieties; particularly as regards their

blooming period. Irish potatoes are not dependable in the irrigated valleys, although some very satisfactory crops are frequently raised in the mountain canyons at high altitudes. Even around Santa Fe potatoes cannot be depended upon.

Dry farming is being done, mostly in the higher altitudes and in the central and southeastern part of the county. Beans, barley, oats and short season corn are among the better dry land crops. If more care were given to the proper conservation of the winter and spring moisture by fall and winter plowing of the land, better yields might be obtained in the growing of some of the dry land crops.

Many cattle and sheep are grazed on the uplands and mesas, and in the canyons. On the whole, there are more sheep raised than cattle.

SIERRA COUNTY

STATION—ELEPHANT BUTTE. APPROX. LAT.—33° 10′. LONGITUDE—107° 10′. ELEVATION—4,265 FT.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Precipitation	1864	.....	.....	0.50	0.00	1.75	6.50	3.00	5.00	4.56	0.25	0.00	.....	.....	.....	
	1865	0.25	.....	0.37	....	....	....	....	....	....	.....	.....	.....	.....	.....	
	1868	.....	.....	....	0.04	0.74	T.	2.82	1.53	1.70	0.49	0.76	0.29	.....	6.83	
	1869	0.40	0.67	0.07	0.32	0.07	2.08	1.19	3.98	T.	0.41	0.94	0.54	10.67	7.64	
	1870	0.00	0.10	T.	0.00	0.21	0.52	4.11	3.67	0.95	0.95	0.00	0.54	11.05	9.46	
	1871	*0.15	0.00	0.00	0.00	0.35	0.45	1.05	3.55	1.25	0.30	0.10	0.10	7.30	6.65	
	1872	0.45	0.00	0.00	0.00	0.45	1.95	3.45	4.60	0.25	0.00	0.00	1.10	12.25	10.70	
	1873	0.00	0.12	0.40	0.20	0.55	0.39	0.05	2.50	1.38	0.08	0.30	0.06	5.97	5.07	
	1874	0.01	0.09	0.60	2.20	0.16	0.10	1.10	3.66	3.90	*0.65	0.00	*0.88	13.35	11.12	
	1875	0.00	.....	0.00	0.00	0.00	....	....	....	4.15	0.00	0.00	0.20	.....	.....	
	1876	0.60	.....	....	....	....	....	....	....	....	.....	.....	.....	.....	.....	
	1895	0.35	0.50	0.00	0.02	0.10	0.76	3.91	2.31	0.25	0.21	0.70	T.	9.11	7.35	
	1896	0.00	0.60	0.00	0.00	0.02	0.27	2.84	2.10	1.10	4.10	0.15	0.26	10.84	6.33	
	1897	0.40	0.00	1.01	1.56	1.20	1.58	3.79	3.38	3.23	0.74	0.00	0.00	16.89	14.74	
	1898	T.	0.60	0.12	0.93	T.	1.78	3.65	4.40	0.70	0.00	1.50	1.30	14.38	11.46	
	1899	0.55	0.11	1.12	0.00	0.00	0.55	3.67	0.40	0.20	0.50	0.00	0.62	7.72	4.82	
	1900	0.23	0.00	1.18	0.00	T.	0.00	0.31	1.92	1.74	0.64	0.00	0.01	6.03	3.97	
	1901	0.04	1.07	0.35	T.	T.	0.25	2.47	1.07	T.	2.17	1.07	0.00	8.49	3.79	
	1902	0.00	0.00	0.03	0.00	T.	T.	1.34	3.32	0.70	*0.25	*0.25	0.30	6.19	5.36	
	1903	*0.15	*0.85	0.83	0.27	0.77	2.39	T.	0.22	1.28	0.00	0.00	0.00	6.76	4.93	
	1904	0.20	T.	....	....	....	0.25	0.50	2.70	5.60	.....	0.00	1.13	.....	.....	
	1905	1.20	1.40	0.40	1.30	0.00	....	0.38	....	....	.....	.....	.....	.....	.....	
	1906	.....	.....	0.00	0.25	0.20	0.00	....	....	....	.....	0.36	2.23	.....	.....	
	1907	0.25	0.00	0.00	....	....	....	....	....	....	.....	.....	.....	.....	.....	
	1908	.....	.....	....	....	....	....	....	3.12	0.63	0.03	0.81	0.04	.....	.....	
	1909	T.	0.03	0.46	0.00	T.	0.02	2.70	1.50	1.13	0.62	T.	0.22	6.68	5.35	
	1910	T.	T.	0.15	0.99	0.25	0.69	1.36	0.97	0.37	0.69	0.32	T.	5.79	4.65	
	1911	0.24	1.80	1.72	0.44	T.	1.60	3.08	0.70	3.06	0.87	T.	T.	13.51	8.88	
	1912	T.	0.20	0.71	1.07	T.	0.53	2.51	3.08	0.23	0.88	T.	1.74	10.95	7.42	
	1913	0.77	0.65	0.70	1.06	0.11	0.86	1.04	2.90	0.46	0.29	2.01	1.42	12.27	6.43	
	1914	0.15	0.02	0.27	0.15	0.48	2.87	4.58	2.56	0.54	0.84	0.34	2.32	15.12	11.18	
	1915	0.53	1.08	1.26	2.26	T.	T.	3.81	1.87	2.28	T.	0.30	0.48	13.87	10.22	
	1916	0.91	0.13	0.63	1.35	2.00	T.	2.53	2.65	0.59	2.72	0.03	0.90	13.73	9.12	
	1917	0.40	T.	0.00	0.05	0.19	0.04	1.64	0.24	0.97	0.00	0.00	0.00	3.53	3.13	
Average		0.27	0.33	0.43	0.49	0.33	0.91	2.25	2.50	1.49	0.62	0.32	0.55	10.49	7.97	

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Av. No. days with precipitation ..		1	2	2	2	1	3	6	5	4	2	1	2	31	21	18
Av. snowfall, in..		1.1	0.7	0.9	0.1	. 0	0	0	0	0	T.	0 6	2.6	6.0		18
Temperature—																
Mean		40.1	43.7	50.1	57.3	66.1	75.3	78.0	77.0	70 3	59.2	47.2	37.8	58.5		
Mean Max.		55.3	58.6	66.0	73.8	83.3	91.7	92.0	90.9	84.6	74.9	63.4	52 1	73.8		18
Mean Min.		24.9	28.8	34.2	40.8	48.9	58.9	64.0	63.0	56 0	42.6	31.1	23.5	43.1		18
Highest		78	81	87	92	101	104	108	106	98	92	82	73	108		
Lowest		−2	−5	14	19	26	34	48	53	36	22	2	−3	−5		
Prevailing wind..		SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW		18
Days clear		19	18	18	20	21	16	11	12	16	22	20	20	213	96	18
Days partly cl'dy..		6	6	8	6	7	11	15	16	10	6	7	6	104	65	18
Days cloudy		6	4	5	4	3	3	5	3	4	3	3	5	48	22	18

Frost—Average date of first killing frost in autumn, Oct. 30.
Average date of last killing frost in spring, April 6.
Earliest date of killing frost in autumn, Oct. 16.
Latest date of killing frost in spring, May 4.
Average length of growing season, 206 days.

*Estimated from nearby stations.

This is a south central county traversed from north to south by the Rio Grande, through its central part. The stream, however, is largely within canyons that prevent its extensive use in irrigation, but which permit the great reservoir of the Elephant Butte Dam. However, there are about 10,000 acres of land under the project, part of which is under irrigation, and part awaiting development. Great variation in altitude and much broken and mountainous country are found within the county west of the Rio Grande. The Black Range of mountains forms its western boundary, and the altitudes increase from about 4,000 feet to 10,000 feet. Precipitation averages about 10 inches along the Rio Grande, but increases to 15 and possibly 18 inches in the mountains. Winds are prevailing southwest to west, and light, and there is much warm, clear, beautiful weather.

Average annual precipitation, 10 to 15 inches, to 18 inches in mountains.

Average seasonal precipitation, 8 to 12 inches.

Average seasonal snowfall, 6 to 9 inches, to 20 inches in mountains.

Mean annual temperature, 50 to 58 degrees.

Mean summer temperature, 70 to 77 degrees.

Mean winter temperature, 33 to 40 degrees.

Farming in this county is carried on for the most part in the little irrigated mountain valleys that extend from the Black Range eastward to the Rio Grande Valley. Approximately one-third of the total acreage of the tilled land is in the Rio Grande Valley.

The irrigated valleys grow excellent fruits, such as peaches, apples, European and native plums, cherries and grapes, while wheat, oats, corn, barley, beans, chile, melons, root crops and alfalfa form other important crops. English walnut trees have been producing good yields for several years in many parts of the county, Monticello possessing one walnut grove of about 100 trees.

Very little dry farming is done, and that principally in the higher altitudes in the Black Range, where small grains and beans may usually be matured, and potatoes grown successfully.

Thousands of head of cattle, horses, sheep and goats range over the prairies and mountains where there is usually ample rainfall to produce fine grass. The grazing of sheep and cattle has always been a prosperous industry in this county.

SOCORRO COUNTY

STATION—ALMA. APPROX. LATITUDE—33° 22′ LONGITUDE—108° 55′. ELEVATION—5,500 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Precipitation	1894	*0.44	*0.77	0.77	T.	1.32	0.00	1.42	2.71	0.53	2.01	0.00	1.24	10.21	4.98	
	1895	1.21	0.33	0.26	0.04	0.49	0.51	3.25	2.03	3.27	1.99	2.65	0.48	16.51	9.59	
	1896	0.21	T.	0.14	0.03	T.	0.30	1.70	4.88	1.24	5.97	0.27	0.35	15.09	8.15	
	1897	2.33	0.47	0.57	0.15	0.11	0.72	3.04	2.16	4.15	1.95	T.	0.38	16.03	10.33	
	1898	2.24	0.27	0.83	1.40	0.04	0.85	4.00	3.54	1.53	0.00	1.05	1.51	17.26	11.36	
	1899	0.26	0.11	0.58	0.31	T.	1.76	5.24	1.75	1.10	0.69	0.70	0.41	12.91	10.16	
	1900	0.29	0.50	0.81	1.81	0.03	T.	1.12	1.53	2.72	1.00	1.24	0.91	11.96	7.21	
	1901	1.46	1.02	0.92	0.10	1.75	0.00	4.87	2.03	1.75	1.68	0.68	0.13	16.39	10.50	
	1902	0.62	0.65	0.38	T.	0.80	....	....	....	....	....	.....	1.61	.....	.....	
	1903	0.01	0.30	0.29	T.	*0.25	1.21	1.46	2.72	2.91	0.00	0.00	*0.10	9.25	8.55	
	1904	.....	.....	....	.....	.....	....	1.00	2.96	0.75	3.18	*0.24	1.50	.....	.....	
	1905	1.44	6.05	5.35	2.40	0.00	0.40	1.85	2.80	2.70	0.45	5.80	0.85	30.09	10.15	
	1906	0.10	1.00	1.10	*0.69	*0.19	0.00	1.70	....	....	....	.....	.....	.....	.....	
	1910	*0.93	T.	0.10	0.86	0.30	0.09	1.65	1.95	1.20	0.55	2.01	0.35	9.99	6.05	
	1911	2.23	1.96	1.13	0.42	0.40	1.44	3.50	1.99	2.65	2.72	0.00	0.98	19.42	10.40	
	1912	0.00	0.10	3.76	0.48	0.08	2.69	3.55	2.39	0.43	2.36	0.00	0.98	16.82	9.62	
	1913	0.65	1.87	0.66	T.	0.06	0.42	2.20	3.46	1.33	1.26	3.03	0.40	15.34	7.47	
	1914	0.02	0.67	0.83	T.	0.24	1.93	3.33	3.47	0.42	3.77	1.89	3.43	20.00	9.39	
	1915	1.45	1.60	0.90	1.68	0.20	0.30	5.27	1.71	1.83	0.37	0.85	1.65	17.18	10.99	
	1916	3.83	0.80	1.60	0.72	0.65	0	3.17	4.15	0.61	4.52	0	0.75	20.80	9.30	
	1917	2.78	0.60	T.	0.45	0.30	0.02	1.75	1.27	1.09	0.06	0.00	0.00	8.26	4.88	
Average		1.12	0.95	1.05	0.58	0.32	0.67	2.75	2.61	1.53	1.81	1.07	0.90	15.36	8.46	
Av. No. days with precipitation ...		4	4	4	3	2	3	11	11	6	4	3	4	59	36	18
Av. snowfall, in..		0.9	0.7	0.2	T.	0	0	0	0	0	0	0.4	5.8	8.0		7
Temperature—																
Mean		38.1	41.3	47.2	53.9	61.8	69.4	74.4	73.3	67.3	56.0	45.8	37.2	55.5		14
Mean Max.		55.5	59.0	66.3	73.4	82.4	90.5	91.3	89.6	84.9	74.1	64.7	54.5	73.8		13
Mean Min.		21.4	23.8	28.7	34.4	41.1	48.7	57.4	57.1	49.8	37.8	26.8	20.1	37.3		13
Highest		79	77	85	92	105	104	106	102	101	98	81	72	106		13
Lowest		–5	5	9	16	23	30	36	44	27	20	4	–13	–13		13
Prevailing wind..		SSW	SW	SW	SW	SW	SW	SW	SSW	SW	S	SSW	SW	SW		14
Days clear		15	11	11	13	15	15	6	6	14	18	19	15	158	69	18
Days partly cl'dy.		9	11	14	12	13	13	17	20	12	9	7	11	148	87	18
Days cloudy		7	6	6	5	3	2	8	5	4	4	4	5	59	27	18

SOCORRO COUNTY (Continued)

Frost—Average date of first killing frost in autumn, Oct. 19.
Average date of last killing frost in spring, April 23.
Earliest date of killing frost in autumn, Sept. 22.
Latest date of killing frost in spring, May 27.
Average length of growing season, 180 days.

*Estimated from nearby stations.

SOCORRO COUNTY

STATION—ARAGON. APPROX. LATITUDE—33° 51′. LONGITUDE—108° 55′. ELEVATION—6,686 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs
Precipitation	1905	....	....	....	....	....	....	....	....	....	.40	2.96	0.51	.....	.....	
	1906	0.39	0.49	T.	.02	....	....	2.55	2.77	1.56	T.	1.82	2.64	.....	.....	
	1907	2.65	0.63	0.37	1.94	0.93	.40	.38	4.76	1.43	1.86	....	0.68	.....	9.84	
	1908	1.42	2.92	1.34	....	1.10	2.62	....	....	....	....	....	....	.....	.....	
	1909	0.15	1.40	1.70	0.10	0	T.	2.20	4.27	2.08	1.80	....	....	.....	8.65	
	1910	2.36	.60	.75	.71	.55	.30	1.14	2.22	0.35	1.03	1.30	0.30	11.55	5.27	
	1911	1.10	1.81	.60	.50	T.	1.35	3.70	1.65	2.75	3.30	0	0.70	17.46	9.95	
	1912	0	.60	3.37	.90	T.	2.00	3.51	0.65	0.30	1.42	0.08	6.51	13.34	7.36	
	1913	0.95	1.98	0.60	0	0.20	0.42	1.75	2.19	1.72	0.67	1.95	1.47	13.90	6.28	
	1914	6.75	0.40	0.45	0	1.28	0.58	4.75	2.52	0.52	2.55	0.75	2.36	16.86	9.65	
	1915	1.96	1.14	0.46	0.90	0.50	0.25	4.13	1.15	0.80	0.30	0.75	2.08	14 42	7.73	
	1916	2.75	0	1.25	1.00	0	T.	2.65	2.88	0.15	4.15	0	0.77	15.60	6.68	
	1917	0.50	0.70	0.08	0.26	0.00	T.	2.20	0.95	1.10	0.00	0.00	0.00	5.79	4.51	
Average..........		1.21	1.06	.99	0.63	0.55	0.53	2.54	2.36	1.16	1.43	0.88	1.27	14.61	7.77	
Av. No. days with precipitation ...		4	4	3	2	1	2	8	8	4	3	3	3	45	25	10
Av. snowfall, in..		4.3	9.4	3.2	0.3	0	0	0	0	0	T.	3.3	7.5	28.0		10
Temperature—																
Mean		30.7	34.0	39.4	45.8	53.4	63.6	67.9	66.8	62.0	50.2	40.8	29.5	48.6		10
Mean Max.		47.6	51.9	68.2	64.9	74.0	83.6	84.4	82.3	78.6	68.8	59.2	47.4	66.7		10
Mean Min.		15.0	17.2	22.0	28.0	34.4	43.7	51.1	51.1	45.4	31.2	21.8	12.2	31.1		10
Highest		67	70	85	87	94	104	105	97	90	84	80	67	105		10
Lowest		−20	−16	−6	11	19	27	38	36	28	10	5	−17	−20		10
Prevailing wind..		SW	SW	SW	SW	SW	SW	SW	..	SW	SW	SW	SW	SW		
Days clear		17	15	16	18	19	18	6	7	15	22	21	18	192	83	
Days partly cl'dy.		7	8	11	9	11	11	21	22	13	7	7	8	135	87	
Days cloudy		7	5	4	3	1	1	4	2	2	3	2	5	38	13	

Frost—Average date of first killing frost in autumn, Oct. 1.
Average date of last killing frost in spring, May 19.
Earliest date of killing frost in autumn, Sept. 22.
Latest date of killing frost in spring, June 17.
Average length of growing season, 135 days.

SOCORRO COUNTY

STATION—MAGDALENA. APPROX. LATITUDE—34° 08′. LONGITUDE—107° 17′. ELEVATION—6,557 FT.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs
Precipitation	1889	....	....	....	....	....	2.50	1.00	1.07	0.43	0.36	1.40	0.05	.....	.....	
	1890	0.80	0.10	0.40	0 80	0	0.20	5.31	....	....	....	....	....	.....	.....	
	1905	....	....	....	4.56	0	1.40	1.35	4.05	1.55	0.07	2.55	1.50	.....	12.91	
	1906	0.03	2.11	0.24	1.38	0.06	T.	0.28	2.75	2.02	0.70	1.47	1.18	12.22	6.49	
	1907	0.81	0.43	0	2.92	0.92	0.79	3.09	3.66	1.16	1.89	0.31	T.	15.98	12.54	
	1908	0.65	0.65	T.	2 99	0.35	0.15	4.36	3.71	0.47	0.60	0.58	0.25	14.76	12.03	
	1909	0.10	0.20	1.81	T.	T.	0.63	3.58	3.57	1.48	T.	0.30	1.18	12.85	9.26	
	1910	0.50	0 09	0.14	0.55	0.52	0.65	2.11	2.86	1.70	0.39	0.67	0.10	10.28	8.39	
	1911	0.86	1.60	1.39	0.52	T.	2.39	5.40	2.00	2.35	2.04	T.	1.33	19.88	12.66	
	1912	T.	0.80	0.10	1 06	0.13	2.19	3.55	4.15	0.10	0.84	0.30	0.76	13.98	11.18	
	1913	0.56	0.42	0.31	0.40	0.10	1.82	0.85	3.32	3.15	0.55	1.36	1.12	13.96	9.64	
	1914	0.05	0 25	0.55	0.70	1.15	0.90	1.70	2.25	0.77	3.30	0.40	1.82	23.84	17.47	
	1915	1.59	0.10	1.25	3.36	....	0	3.23	....	....	....	0	0.63	.....	.....	
Average..........		0.54	0.61	0.56	1.60	0.29	1 05	3.52	3.04	1.38	0.98	0.78	0.83	15.18	10.88	
Av. No. days with preciptiation ...		3	3	3	4	2	5	10	11	7	4	3	3	58	39	11
Av. snowfall, in..		2.5	7.6	3.2	2.0	T.	0	0	0	0	1.2	2.5	8.4	27.4		11
Temperature—																
Mean		36.2	37.3	44.2	50.5	59 2	68.8	70.2	67.8	62.2	51.8	41.7	32.4	51.8		10
Mean Max.		49.2	51.2	59.1	65.9	76.1	85.0	84.4	81.2	76.8	66.7	56.6	45.4	66.5		10
Mean Min.		23.2	23 4	29.3	35.2	42.2	52.5	56.0	54.4	47.6	36.9	26.8	19.5	37.2		10
Highest		70	67	84	89	91	102	102	95	90	86	78	68	102		10
Lowest		–4	–3	0	14	20	35	45	47	25	11	–4	–21	–21		10
Prevailing wind..		W	W	W	W	W	W	W	W	W	W	W	W	W		
Days clear		19	14	17	17	19	17	8	7	16	20	19	18	191	84	11
Days partly cl'dy.		9	10	11	10	11	11	20	22	12	9	8	10	143	86	11
Days cloudy		3	4	3	3	1	2	3	2	2	2	3	3	31	13	11

Frost—Average date of first killing frost in autumn, Oct. 13.
Average date of last killing frost in spring, May 1.
Earliest date of killing frost in autumn, Sept. 26.
Latest date of killing frost in spring, May 29.
Average length of growing season, 165 days.
Years recorded, 10.

SOCORRO COUNTY

STATION—SOCORRO. APPROX. LATITUDE—34° 04′. LONGITUDE—106° 54′. ELEVATION—4,600 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Precipitation	1849	....	....	....	....	....	....	....	....	....	....	1.76	0.80	.....	.....	
	1850	0.05	0.52	0.60	0.42	0.12	0.17	1.29	0.54	0.24	1.81	0.92	0.44	7.12	2.78	
	1851	0.02	0.45	....	0.45	0.01	0	0.40	2.07	....	....	....	....	.....	.....	
	1879	....	....	....	....	....	....	2.24	1.46	1.95	2.10	0.03	0.01	.....	.....	
	1880	0.15	0.03	0.11	0.05	0.14	0.80	3.85	0	2.07	2.81	0.81	3.54	14.36	6.91	
	1881	0.55	0.01	0.07	0.23	0.51	....	....	....	....	....	....	....	.....	.....	
	1891	....	....	....	....	....	....	....	....	....	0	0	1.05	.....	.....	
	1892	0.90	0.18	0.50	T.	T.	0.52	1.09	0.17	0.07	0.61	0	0.27	4.31	1.85	
	1893	0.57	0.22	0	0	0.88	0.03	1.78	1.11	3.47	T.	T.	T.	8.06	7.27	
	1894	0.14	0.29	0.55	0.25	0.20	T.	0.29	2.58	0.16	....	....	....	.....	3.48	
	1895	....	....	....	T.	1.13	1.26	4.09	....	....	....	....	....	.....	8.29	
	1896	....	....	....	....	....	0.43	3.00	0.88	1.35	4.89	0	0.02	.....	5.94	
	1897	0.51	0.05	0.58	1.00	1.20	0.57	2.03	1.02	2.47	1.18	0	0	10.61	3.53	
	1898	0.78	0.44	0.92	....	....	....	....	....	....	0.04	0.69	0.55	.....	6.19	
	1899	0.01	0	0.80	1.32	0.04	0.22	3.18	0.30	0.88	0.18	0.46	0.32	7.71	5.94	
	1900	1.35	0.50	0.66	0.18	0.46	0.19	0.47	0.48	1.75	0.60	0.13	0.28	7.05	3.53	
	1901	T.	1.14	0.01	0.21	0.72	0.04	1.98	0.99	2.25	1.39	1.32	0.01	10.06	6.19	
	1902	0.66	0.06	T.	0	0.27	0.13	0.96	....	....	....	....	....	.....	.....	
	1904	....	....	....	....	....	....	....	....	4.20	1.92	0.06	1.12	.....	.....	
	1905	1.05	1.11	1.27	2.60	0.07	1.73	0.84	1.32	7.96	0.25	2.97	1.23	22.40	14.52	
	1906	0.49	1.41	0.17	0.65	0.23	0	1.32	2.27	0.72	1.30	0.67	2.37	11.60	5.19	
	1907	1.05	0.10	0	1.95	1.15	0.55	1.22	5.41	2.47	3.00	0.95	0	17.85	12.75	
	1908	0	0.48	0.04	2.05	0.35	0.06	0.93	1.35	0.35	0.04	0.61	0.03	6.29	5.09	
	1909	0.15	0.26	1.52	0	0.08	0.18	1.73	1.31	1.09	0.75	0	1.04	8.11	4.39	
	1910	0.15	T.	0.05	0.88	0.18	1.55	0.80	1.65	0.39	1.57	0.34	0.06	7.62	5.45	
	1911	0.94	2.28	1.45	1.18	0.26	1.36	2.58	0.46	2.49	2.29	0.08	0.75	16.12	8.33	
	1912	0	0.08	0.64	0.84	0.13	1.32	0.75	2.39	0.06	0.37	0	0.65	8.01	5.49	
	1913	0.43	0.30	0.45	0.70	0.03	1.54	0.79	1.10	0.48	0.25	0.83	1.20	8.10	4.64	
	1914	0.12	0.08	0.05	0.51	1.68	0.78	4.52	3.41	0.78	2.41	0.35	3.12	17.81	11.68	
	1915	0.61	0.64	1.16	2.56	0.10	0.05	5.65	0.42	4.27	0.50	0.12	0.49	16.57	13.05	
	1916	0.79	0.05	1.57	2.21	0.10	0	2.24	2.99	0.38	5.56	0.20	0.29	16.38	7.92	
	1917	0.58	0.28	0.14	0.16	0.48	0.00	0.35	0.94	1.73	0.03	0.00	0.00	4.69	3.66	
Average..........		0.46	0.44	0.53	0.78	0.40	0.52	1.87	1.46	1.76	1.38	0.49	0.72	19.81	6.79	
Av. No. days with precipitation...		3	3	3	4	3	3	9	8	6	4	3	3	52	33	20

SOCORRO COUNTY (Continued)

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Av. snowfall, in..		1.7	2.1	1.2	0.6	0	0	0	0	0	0.7	0.7	2.3	9.3		18
Temperature—																
Mean		37.9	42.1	49.7	57.6	65.8	75.4	77.4	75.9	69.1	58.0	45.7	36.2	57.6		25
Mean Max.		52.7	58.1	65.7	74.4	83 8	93.4	92.3	91.2	85.6	74.4	62.9	51.4	73.8		21
Mean Min.		23.6	26.6	32.7	40.3	47.4	56.9	61.8	59.8	51.7	39.4	28.9	21.2	40.9		21
Highest		76	80	91	94	102	108	108	106	99	95	86	81	108		21
Lowest		–13	1	9	15	28	40	42	45	27	16	6	–16	–16		21
Prevailing wind..		N	N	S	S	S	S	S	S	SE	N	N	N	S		20
Days clear		24	21	24	23	25	24	17	17	20	23	25	22	265	126	
Days partly cl'dy.		4	4	5	5	4	5	12	11	7	4	3	5	69	44	
Days cloudy		3	3	2	2	2	1	2	3	3	4	2	4	31	13	

Frost—Average date of first killing frost in autumn, Oct. 19.
Average date of last killing frost in spring, April 4.
Earliest date of killing frost in autumn, Sept. 27.
Latest date of killing frost in spring, May 1.
Average length of growing season, 198 days.
Years recorded, 22.

This is a west central county, the largest in the state, with a great diversity of altitude, contour and climate. Its eastern portion is traversed from north to south by the Rio Grande, and several thousand acres are under irrigation; but there is much upland and mountain country, both east and west, with western ranges exceeding 10,000 feet and many miles of plateau and broken country from 6,000 to 7,000 feet in altitude. The rainfall in the valley of the Rio Grande averages about 10 inches annually, but increases with altitude to 15, 18 and probably 20 inches. The valley is hot, dry and fertile, the uplands cooler, more moist, and almost equally fertile, though largely given to grazing. Winds are prevailing south to west and fresh over the upland districts. Much clear weather occurs.

Average annual precipitation, 10 to 15 inches, to 18 or 20 inches in mountains.

Annual seasonal precipitation, 7 to 10 inches, to 15 inches in mountains.

Average seasonal snowfall, 10 to 20 inches, to 30 and 50 inches in mountains.

Mean annual temperature, 52 to 58 degrees.

Mean summer temperature, 68 to 76 degrees.

Mean winter temperature, 33 to 39 degrees.

In this county the agriculture is largely being carried on in the Rio Grande Valley, where all of the temperate zone fruits, with the exception of apricots, almonds, sweet cherries and Japanese plums, are considered successful. Alfalfa, wheat, oats, barley, corn, feed sorghums, beans, field and garden peas, chile, melons, cabbage, beets, and other root crops, are being successfully raised. In the western part, in among the mountains and in the little valleys, where water for irrigation may be had, some farming is also being carried on; and the crops that are raised in the lower Rio Grande basin can also be raised in these little intermontane districts, with the exception of some of the warm and long season crops, such as chile, tomatoes, melons, sorghum and long season corn. The altitude and moisture are limiting factors as regards the growing of a large number of crops. In the high altitude and mountainous districts, where there is enough rainfall for successful dry farm-

ing, beans, short season corn, wheat, watermelons, barley, oats, and pumpkins are raised. Potatoes grow more successfully from 7,500 feet up. It is reported that two years ago beans were raised at the rate of 1,700 pounds to the acre. Considerable of the higher country east as well as west of the Rio Grande is capable of being farmed under dry farming conditions, as the rainfall is greater there than in the valley.

The mesas, plateaus and mountains afford excellent pasture for grazing sheep, cattle and goats. This is one of the banner stock raising counties of the state, having almost twice as many sheep as any other county, and being exceeded in the number of cattle by only one other county.

TAOS COUNTY

STATION—TAOS. APPROX. LATITUDE—36° 30′. LONGITUDE—105° 35′. ELEVATION—6,983 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs
Precipitation	1889	0.90	0.10	0.24	1.08	0.17	1.21	2.70	1.64	1.22	0.78	0 54	0.52	11.10	8.02	
	1890	0.90	0.62	0.89	1.98	0	0.29	2.55	2.64	0.88	0 79	0.80	1.39	13.73	8.34	
	1891	0.39	1.34	1.01	0	2.85	1.34	1.17	0.40	3.55	0	0	2.26	14.31	9 31	
	1892	0.96	1.35	1.69	0.57	0.75	0.84	1.60	T.	T	0.85	0.27	0.65	9.53	3.76	
	1893	0.97	1.32	1.10	T.	1.62	T.	0.70	2.29	2.09	0	T.	0 17	10.26	6.70	
	1894	0.68	0.79	0.91	0.67	1.39	0.15	1.17	2.11	1.87	0.93	....	....	.....	7.36	
	1895	....	....	0.26	0.21	3.60	1.18	3.84	2.20	0 26	1.31	1.40	1.60	.....	11.29	
	1896	0.52	0.39	0.48	....	....	....	....	....	....	....	....	....	.....	.....	
	1901	....	....	....	....	....	....	....	....	....	....	0.88	0.40	.....	.....	
	1902	0.50	0.15	0.97	T.	1.90	T.	0.53	2.57	0.98	0.30	2 00	0.95	10.75	5.98	
	1903	0.25	1.93	1.40	1.58	T.	3.56	0.37	2.26	0 30	T.	0	0.10	11.75	8.07	
	1904	0.40	0.90	1.28	0.15	0.25	2.01	0.77	1.18	3.06	1.26	0 21	0.30	11.77	7.52	
	1905	1.16	2.09	0.64	1.80	0.47	1.27	2.94	0.68	0 97	1.35	1.72	T.	15.09	8.13	
	1906	0.26	0.75	1.66	1.18	0.82	0.76	3.05	1.25	1.25	0.89	0 91	0.74	14.52	8.31	
	1907	1.42	0.23	0.62	1.04	1.80	0.47	1.02	5.21	0 55	1.24	0.03	0.11	13.74	10.09	
	1908	2.11	0.97	0.48	2.87	1.33	T.	2.75	2.33	0.92	0.46	0 69	0.40	15.31	10.20	
	1909	1.06	1.04	0.46	1.55	....	....	....	1.81	0 90	1.40	0.71	0.69	.....	.....	
	1910	1.07	1.15	0.27	0.88	0.46	0.37	1.24	1.80	0.26	0.31	0 42	0.71	8.94	5.01	
	1911	0.94	2.00	1.41	0.67	1.28	1.14	2.67	1.82	2 40	3.24	0.81	0.40	18.78	9.98	
	1912	0.06	0.29	3.00	0.93	0.77	1.97	0.90	0.95	0.38	0.28	0.20	0 04	9.77	5.90	
	1913	0.31	1.00	0.72	1.16	0.33	1.52	1.02	1.34	1 88	0.26	1.13	1.05	11.72	7.25	
	1914	0.30	0.47	0.44	1.01	2.17	1.04	1.92	1.23	0.56	1.50	0	1.06	11 70	7.93	
	1915	0.51	0.86	0.69	3.77	2.75	0.51	1.15	1.31	1 20	0.01	0.38	0.32	13.46	10.69	
	1916	3.39	0.23	0.85	2.08	0.83	0.24	0.90	1.15	0.54	3.26	T.	0 60	14.07	5.74	
	1917	0.86	0.28	0.55	1.06	2.33	0.15	2.14	0.53	0.34	0 26	0.21	T.	8.71	6.55	
Average		0.86	0.88	0.92	1.14	1.36	0.96	1.64	1.68	1.15	0.86	0 58	0.61	12.64	7.93	
Av. No days with precipitation ...		5	4	5	6	6	5	9	8	5	3	3	4	63	40	21
Av. snowfall, in..		5.7	7.7	3.2	1.9	0.6	0	0	0	T.	1.9	2.1	5.8	28 9		10
Temperature—																
Mean		27.3	31.8	40.0	47.9	55.2	62.8	68.1	67.0	60.2	49.3	38 4	26.3	47.9		18
Mean Max.		41.6	46.2	55.0	64.4	72.3	81.8	85.1	83.8	77.8	66 8	55.0	41.6	64.3		18
Mean Min.		13.0	17.4	25.0	31.4	38.2	43.7	51.1	50.2	42.6	31.8	21 9	11.0	31.4		18
Highest		60	67	78	82	92	101	101	99	95	89	77	67	101		19
Lowest		–20	–15	–5	10	21	30	34	37	25	11	–5	–23	–23		19

TAOS COUNTY (Continued)

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs
Prevailing wind..		SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW		
Days clear		19	15	17	17	18	19	12	15	19	23	21	19	214	100	
Days partly cl'dy.		8	9	11	10	10	10	17	14	10	6	7	9	121	71	
Days cloudy		4	4	3	3	3	1	2	2	1	2	2	3	30	12	

Frost—Average date of first killing frost in autumn, Sept. 30.
Average date of last killing frost in spring, May 19.
Earliest date of killing frost in autumn, Sept. 14.
Latest date of killing frost in spring, June 11.
Average length of growing season, 133 days.

This is a northern border county, traversed from north to south by the Rio Grande, which passes through a deep canyon and is not available for irrigation. Very little of the county is below 6,000 feet in altitude, and much of its eastern and western borders exceeds 8,000 feet, rising above 13,000 feet at the crest of the range. The precipitation on the lower levels is light, averaging about 12 to 16 inches, but rising rapidly in the foothills and mountains to 18, 20 and possibly 25 to 28 inches, with heavy snow and long, severe winters. Winds are prevailing southwesterly and light to fresh, while much clear weather occurs, with rather short growing season, especially over the plateau and foothill districts.

Average annual precipitation, 12.6 to 16 inches, to 18, 20 and 25 inches in mountains.

Average seasonal precipitation, 8 to 12 inches, to 15 and 20 inches in mountains.

Average seasonal snowfall, 28 to 40 inches, up to 100 inches in mountains.

Mean annual temperature, 44 to 48 degrees.

Mean summer temperature, 62 to 66 degrees.

Mean winter temperature, 26 to 28 degrees.

Practically all of the irrigation farming is done on the west side of the Sangre de Cristo Range and east of the Rio Grande Gorge, comprising an area known as the Taos Basin or Taos Valley, watered by the Red, Taos, Hondo and Cabresto Rivers. In the past this was known as the "Granary of New Mexico," and wheat has, for many years, been the principal crop raised. The so-called San Luis Valley pea, or Colorado stock pea, originated in the Taos Valley, where it is grown very extensively. At present wheat, field peas, barley, oats, some corn, beans, cabbage, carrots, and turnips are grown successfully. On account of the high altitude of the valley, tomatoes, chile and other long, warm season crops are not very successfully raised. Alfalfa and Vega grass are the principal forage crops. The Irish potato does not seem to be a success in the valley, but on the slope of the Sangre de Cristo Range, where the rainfall is quite heavy, some good Irish potatoes are raised.

Some dry farming is done, west of the Rio Grande Gorge; but the rainfall in many cases, particularly in the valleys, is not sufficient for successful dry farming, although the New Mexico Pinto bean can be raised almost every year under dry farming methods. In the higher altitudes and mountain districts, where the seasonal precipitation is greater, the chances are better for successfully growing some of the short season crops under dry farming conditions. Apples, sour cherries, native plums and European plums are the principal fruits grown.

This is an important stock raising county. Sheep, goats and cattle are grazed on the mesas and plateaus and in the mountains. The raising of hogs is becoming an important industry, also.

TORRANCE COUNTY

STATION—ESTANCIA. APPROX. LATITUDE—34° 45′. LONGITUDE—106° 04′. ELEVATION—6,140 FEET.

	Year	Jan.	Feb.	Mar.	Apr.	May.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Precipitation	1889	....	....	.....	....	....	....	8.24	0.16	0.52	1.68	0 82	0.24	......	.....	
	1890	0.14	0.56	*0.75	1.57	0.09	0.20	4.53	1.65	1.49	0.15	0.83	0.22	*12.18	9.53	
	1891	0.74	0.81	1.42	0	2.24	0.60	1.42	0.86	1.73	0	0.15	1.15	11.12	6.85	
	1892	1.15	0.13	0.81	....	....	....	....	....	....	....	....	....	......	.....	
	1904	....	....	.....	....	....	....	....	....	....	....	0 10	0.75	......	.....	
	1905	1.00	0.94	0.38	2.69	0.01	1.13	....	1.07	1.16	....	....	....	......	.....	
	1906	0.08	0.33	0.69	1.37	0.03	0	4.41	1.73	1.49	2.17	1.33	1 13	14.76	9.03	
	1907	0.40	0.21	0.00	1.97	1.22	0.90	0.56	4.71	0	1.94	2 11	0.89	14.91	9.36	
	1908	0.20	*T.	0.13	3.54	0.78	0	4.46	....	....	....	....	....	......	.....	
	1909	....	....	.....	....	....	....	0.99	1.30	1.25	1 36	0.10	0.78	......	.....	
	1910	0.21	0.87	0.14	0.24	.04	0.20	0.44	2.59	1.96	2.04	0 54	0.17	9.44	5.47	
	1911	1.57	2.00	0.56	0.87	0.33	1.01	7.79	1.88	0.55	1 54	0.14	0.89	19.13	12.43	
	1912	0.15	1.40	0.58	....	....	....	....	....	....	0.16	0 06	0.35	......	.....	
	1913	1.05	0.61	0.45	1.03	T.	1.07	1.21	0.73	1.49	0 12	1.52	1.01	10.29	5.53	
	1914	0.03	0.38	0.12	0.59	1.65	1.39	3.15	2.27	1.16	2.63	0 22	1.59	15.13	10.21	
	1915	0.93	1.28	1.21	1.91	0.89	0.28	4.14	1.47	1.59	0 16	0.48	0.89	15.23	10.28	
	1916	2.25	0.17	2.45	2.24	T.	0	2.22	2.64	0.36	4.55	0.25	0.22	17.35	7.46	
	1917	0.39	0.79	0.21	0.21	0.88	0.24	0.91	1.27	2.37	0 00	0.46	0.00	7.73	5.88	
Average		0.69	0.70	0.66	1.40	0.62	0.57	3.18	1.74	1.22	1.32	0 61	0.69	13.40	8.73	
Av. No. days with precipitation ...		3	3	3	5	2	3	8	9	5	4	2	4	51	32	11
Av. snowfall, in..		5.0	6.9	3.8	3.1	0.2	0	0	0	0.1	1.2	3.0	6 8	30.1		11
Temperature—																
Mean		31.4	34.5	42.6	49.4	56.2	65.8	69.2	69.4	61.2	49.5	39.4	29 6	49.8		
Mean Max.		46.1	50.1	59.9	60.8	75.7	85.5	88.0	87.3	80 6	68.5	58.6	45.5	67.2		11
Mean Min.		16.9	19.0	25.3	31.1	37.4	45.6	51.1	52.0	42.5	30.5	20.8	12 1	32.0		11
Highest		64	69	77	82	87	94	94	92	85	77	77	69	94		11
Lowest		–30	–21	0	6	21	31	35	36	27	10	–5	–33	–33		11
Prevailing wind..		NW	W	E	W	W	SW	E	E	E	E	E	NW	E		11
Days clear		18	17	18	17	20	19	13	14	17	20	21	18	212	100	11
Days partly cl'dy.		9	7	11	10	10	9	16	14	11	8	6	9	120	70	11
Days cloudy		4	4	2	3	1	2	2	3	2	3	3	4	33	13	11

TORRANCE COUNTY (Continued)

Frost—Average date of first killing frost in autumn, Oct. 4.
Average date of last killing frost in spring, May 9.
Earliest date of killing frost in autumn, Sept. 12.
Latest date of killing frost in spring, June 13.
Average length of growing season, 146 days.
Years recorded, 11.

*Computed from nearby stations.

TORRANCE COUNTY

STATION—MOUNTAINAIR. APPROX. LATITUDE—34° 31′. LONGITUDE—106° 20′ ELEVATION—6,547 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Precipitation	1902	....	....	....	....	1.60	0.76	0.19	4.93	1.30	0 37	1.76	2.77	.....	.....	
	1903	0.60	5.39	0.46	0.43	0.06	2.96	0.52	1.71	0.36	*T.	0	0.52	13.01	6.04	
	1904	0.10	*T.	0.14	0.14	0.57	2.38	1.11	2.45	2.66	0 98	0.03	0.34	10.90	9.31	
	1905	0.72	1.64	1.09	3.66	0.32	1.11	2.47	1.60	3.12	0.31	3.74	3.04	22.82	12.28	
	1906	0.40	1.11	0.28	....	....	....	....	....	1.43	1.96	1.49	2.84	.....	.....	
	1907	1.38	0.31	0.06	2.68	4.24	0.12	1.19	4.88	1.99	3.45	2.22	0.34	22.86	15.10	
	1908	0.60	0.51	0.36	3.00	0.61	0.66	4.78	2.50	0.78	0.67	1.73	0.37	16.57	12.33	
	1909	0.18	0.80	4.92	0.22	0.18	0.06	2.31	2.53	1.90	1.61	T.	1.79	16.50	7.20	
	1910	0.46	1.24	0.27	1.32	0.25	0.86	2.24	3.28	0.46	0.87	0 86	0.45	12.56	8.41	
	1911	1.62	2.73	0.81	1.44	1.14	0.34	5.07	1.10	3.28	2 00	T.	0.96	20.49	12.37	
	1912	T.	1.38	0.77	0.24	0.32	2.30	4.15	1.62	1.78	0.64	0 30	1.22	14.72	10.41	
	1913	1.15	0.48	0.59	0.77	0.02	0.79	1.33	4.30	2.09	T.	....	....	.....	9.30	
	1914	....	....	0.03	2.10	2.35	0.75	4.87	2.11	0.93	2.24	0	3.80	19.48	13.11	
	1915	1.13	1.01	2.28	2.26	0	0	4.79	1.30	....	....	....	....	.....	.....	
	1917	0.63	1.74	0.27	0.53	0.97	T.	3.01	2.37	1.28	T.	T.	0.00	10.80	8.16	
Average........		0.64	1.26	0.88	1.45	0.90	0.94	2.72	2.62	1.67	1 08	0.93	1.34	16.43	10.30	
Av. No. days with precipitation ...		4	4	5	4	2	4	8	11	6	4	2	4	58	31	12
Av. snowfall, in..		4.5	11.8	6.3	3.0	0.7	0	0	0	0.2	1.5	4.9	12.8	45.7		14
Temperature—																
Mean		33.0	35.2	43.2	49.4	57.5	66.4	69.6	68.6	62.2	50.2	40.0	30.5	51.0		14
Mean Max.		45.5	48.9	58.5	65.9	75.2	84.2	85.9	84.2	78.0	66.7	54.5	43.6	66.3		14
Mean Min.		20.5	21.5	27.9	32.9	39.9	48.6	53 4	53.1	46.4	33.7	25.4	17.4	35.7		14
Highest		68	85	83	87	92	99	99	97	92	86	75	68	99		14
Lowest		–21	–12	0	13	23	32	40	40	24	7	–2	–14	–21		14
Prevailing wind...		SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW		12
Days clear		21	17	19	20	20	18	17	18	20	22	21	20	233	113	
Days partly cl'dy.		7	6	8	6	8	10	10	10	7	6	5	6	89	51	
Days cloudy		3	5	4	4	3	2	4	3	3	3	4	5	43	19	

Frost—Average date of first killing frost in autumn, Oct. 3.
Average date of last killing frost in spring, May 7.
Earliest date of killing frost in autumn, Sept. 8.
Latest date of killing frost in spring, May 29.
Average length of growing season, 149 days.

This is a central county, with altitudes ranging from 5,800 to about 12,000 feet, and much of the county above 6,000 feet. The central part of the county is occupied by the Estancia Valley, and upland surrounded by great stretches of rolling mesa, foothills and mountains. The lowest portions of the valley have an annual precipitation of about 13 inches, which increases over the mesas to 14, 16 and possibly 18 inches, and to 25 or 30 inches in the highest mountains. Winds are prevailing south to southwest and fresh in the open valley and over the mesas. Much clear weather occurs.

Average annual precipitation, 13 to 16 inches, and to 25 or more in mountains.

Average seasonal precipitation, 9 to 12 inches.

Average seasonal snowfall, 30 to 45 inches, to 75 and more in mountains.

Mean annual temperature, 50 degrees.

Mean summer temperature, 68 degrees.

Mean winter temperature, 33 degrees.

Practically all of the farming done in this county is under dry land methods; and the larger per cent of it is done in the Estancia Valley, particularly between the Manzano Mountains on the west and the New Mexico Central railway on the east. The New Mexico Pinto bean is the principal commercial crop raised in the county. Large areas are planted to this bean, and the yield depends upon the amount of rainfall; but it will run from two to five hundred pounds on an average, with occasional large yields of one thousand to fifteen hundred pounds to the acre. Wheat, short season corn, some Sudan grass, some of the feed sorghums, and cowpeas may be grown in a small way. Potatoes are also grown in the county; and the best crops are raised up in the Manzano Mountains at the higher altitudes. If the land had sufficient water for irrigation it could raise immense crops of a large variety of plants; but because of the high altitude and the necessity of depending on the natural rainfall, the number and variety of crops is comparatively small. In the small irrigated valleys next to the Manzano Mountains a larger variety of crops is being grown, such as beans, peas, carrots, turnips, cabbage, celery, wheat, oats and barley. There is very lit-

tle fruit raised in this county, on account of the small amount of irrigated land, although the county claims to have the oldest apple orchard in the state, which is located near the town of Manzano, and is irrigated from a spring. These apple trees are claimed to be something like 200 years old. A number of small orchards, principally apples, have been planted at the foot of the mountains, where water may be had for irrigation. A few orchards have also been started under dry farming conditions, and fairly good results have been obtained. However, the dry farmers have specialized in the growing of the New Mexico Pinto bean, which is a great cash crop in this county; having produced approximately seven million pounds in 1916 and four million five hundred thousand pounds in 1917, although these have been two of the driest years that the weather bureau office has on record.

Many of the high mesas and mountain districts afford excellent grazing for both cattle and sheep. Dry farming and stock raising are the principal industries.

UNION COUNTY

STATION—ALBERT. APPROX. LATITUDE—35° 56′. LONGITUDE—103° 50′. ELEVATION—4,700 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Precipitation	1890	.....	....	....	....	0.43	1.22	3.23	3.06	0.29	0.43	0.28	0.74	.....	.....	
	1891	0.46	0.17	1.22	0.11	2.60	4.07	3.62	0.98	2.66	0.16	T.	2.98	19.03	14.04	
	1892	0.28	0.15	2.50	0.77	1.35	0.18	0.85	0.96	0.32	1.95	0.24	0.89	10.44	4.43	
	1893	0.00	0.20	0.15	0 07	1.23	0.37	1.84	4.79	3.71	0.16	0.00	0.01	12.53	12.01	
	1894	0.00	0.65	0.00	0.92	3.41	3.57	1.38	2.91	2.49	T.	0.00	T.	15.33	14.68	
	1895	0.22	0.93	0 08	0.10	3.79	2.35	11.51	2.24	0.00	1.19	0.99	0.20	23.60	19.99	
	1896	0.35	0.11	0.08	1.02	0.23	1.87	2.56	0.51	4.40	3.37	0.43	3.25	18.18	10.59	
	1897	0.45	0.65	0.55	0 32	3.00	4.27	1.56	2.81	0.42	1.79	0.00	0.09	15.91	12.38	
	1898	0.22	0.00	0.07	1.04	1.30	2.35	4.52	1.58	0.58	0.07	0.60	2.18	14.51	11.33	
	1899	0.05	0.72	0.05	0.00	0.60	0.72	5.66	0.38	2.40	0.39	1.35	0.44	12.76	9.76	
	1900	0.84	0.37	0.45	4.08	4.15	1.83	2.32	2.12	2.20	1.50	0.00	0.20	20.06	16.70	
	1901	0.23	0.44	0.25	2.24	5.14	0.79	3.21	5.00	1.83	1.03	1.80	0.05	22.01	18.21	
	1902	0.08	0.00	0.24	0.58	3.76	0.47	1.19	2.58	T.	0.47	0.84	0.75	10.96	8.58	
	1903	T.	1.58	T.	0.81	0.27	5.90	1.90	2.24	T.	0.33	0.00	T.	13.03	11.12	
	1904	T.	T.	T.	0.13	1.74	3.22	4.16	2.97	6.00	1.30	0.00	0.71	20.23	18.22	
	1905	0.70	1.12	2.90	4 53	3.33	0.81	1.48	0.88	2.42	0.45	4.49	T.	23.11	13.45	
	1906	0.20	0.11	0.08	1.55	0.41	1.00	4.66	0.95	2.59	0.48	0.70	0.88	13.61	11.16	
	1907	0.91	0.04	0 00	2.12	1.30	1.50	2.07	3.28	0.68	0.45	0.55	0.20	13.10	10.95	
	1908	0.13	1.45	0.00	2.56	0.32	0.40	0.88	3.43	1.12	1.19	0.75	T.	12.23	8.71	
	1909	0.00	0.00	1.44	0 75	2.30	1.51	0.64	3.64	4.86	2.16	2.21	0.52	20.03	12.90	
	1910	T.	0.36	0.00	0.23	0.20	2.01	1.71	3.63	0.50	0.86	0.26	T.	9.76	8.08	
	1911	0.20	0.85	0 00	0.35	3.40	0.05	2.49	2.49	1.91	0.56	T.	0.80	13.10	10.69	
	1912	0.00	0.95	0.98	1.26	3.65	3.53	0.92	0.84	1.49	T.	0.00	0.08	13.70	11.69	
	1913	*0.22	0.48	0.03	2 84	0.53	6.57	0.73	1.11	2.33	0.00	0.74	3.63	19.21	14.11	
	1914	0.00	T.	T.	3.68	4.75	1.97	4.74	....	....	....	....	....	.....	.....	
	1915	0.70	1.03	0 92	5.67	2.16	0.03	2.46	3.77	0.87	0.74	T.	0.18	18.53	14.96	
	1916	0.28	0.00	0.14	0.94	T.	0.12	0.56	1.06	0.71	1.82	0.09	0.43	6.15	3.39	
	1917	0.85	0.41	0.37	0.62	2.88	1.01	1.68	3.78	0.70	0.41	0.45	0.06	13.22	10.67	
Mean		0.27	0.47	0.46	1.45	2.07	1.91	2.60	2.29	1.75	0.86	0.62	0.71	14.97	11.61	
Av. No. days with precipitation ...		1	2	1	3	5	5	7	6	3	3	1	1	38	29	24
Av. snowfall, in..		1.4	3.8	1.4	0.8	T.	0	0	0	0	T.	1.6	2.9	11.9		22

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Temperature—																
Mean		38.4	38.5	47.8	55.6	64.4	73.1	77.0	76.7	72.6	57.8	46.9	38.1	57.2		24
Mean Max.		52.9	53.1	63.8	71.4	79 2	88.6	91.3	91.0	84.3	72.9	61.1	52.2	71.8		21
Mean Min.		24.5	24.3	32.7	40.0	49.5	58.1	62.7	61.8	55.3	42.9	31.8	23.9	42.3		21
Highest		78	85	92	92	104	108	104	103	100	91	83	77	108		21
Lowest		–10	–10	2	20	25	41	49	46	31	24	8	–2	–10		21
Prevailing wind..		W	W	W	SW	W	W	SW	SW	SW	W	W	SW	W		13
Days clear		22	17	19	17	17	15	15	17	21	23	20	20	223	102	
Days partly cl'dy.		5	6	8	8	11	11	13	11	6	4	6	7	96	60	
Days cloudy		4	5	4	5	3	4	3	3	3	4	4	4	46	21	

Frost—Average date of first killing frost in autumn, Oct. 25.
Average date of last killing frost in spring, April 18.
Earliest date of killing frost in autumn, Sept. 27.
Latest date of killing frost in spring, May 14.
Average length of growing season, 190 days.
(Data for the years 1915, 1916 and 1917 obtained at Roy, N. M.)
Years recorded, 17.

*Estimated from nearby stations.

UNION COUNTY

STATION—CLAYTON. APPROX. LATITUDE—36° 23′. LONGITUDE—103° 07′. ELEVATION—5,178 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Precipitation	1896	0.24	0 25	0.23	0.68	0.12	1.51	2.63	0.45	*2.23	2.00	0.90	0.22	*13.46	9.62	
	1897	0.38	1.10	0.00	1.05	4.45	3.29	1.26	1.79	0.35	1.67	0.00	1.15	16.49	12.19	
	1898	0.40	0.05	T.	1.27	2 07	3.15	2.44	2.30	0.90	0.07	0.55	0.85	14.05	12.13	
	1899	0.40	*0.59	*0.42	0.00	0.53	1.35	10.51	0.00	*3.63	0.40	2.00	0.40	*20.23	16 02	
	1907	....	....	....	...	...	...	....	7.24	1.85	0.17	...	...	.....	....	
	1909	T.	T.	1.85	1.33	3.52	2.62	1.90	1 92	2.06	1.11	2.04	0.70	19.05	13.35	
	1910	0.10	0.27	0.00	0.92	1.80	1.48	2.88	1.98	0.45	T.	0.27	T.	10.15	19 51	
	1911	T.	0.91	T.	0.78	3.66	T.	5.81	3.03	1.52	....	....	...	....	14.80	
	1913	*0.26	*0.96	0.10	2.94	1.24	3.48	1.20	1 86	3.41	1.50	1.43	2.06	*20.44	19.48	
	1914	0.26	0.25	0.16	7 04	6.74	1.40	3.25	0.85	0.20	2.28	0.00	0.42	22.85	18.30	
	1915	0.29	1.52	0.72	6.36	3.29	1.39	4.01	1.98	1.27	0.65	0.00	0.16	21.64	14.49	
	1916	0 67	0.00	0.27	1.26	0.54	3.39	1.48	2.42	0.15	0.71	0.11	0.13	11.13	9.24	
	1917	0.35	0.59	0.57	0.70	1.96	0.77	1.82	4.23	1.06	0.28	1.42	0.03	13.78	10.54	
Mean		0.28	0.54	0.36	2.19	2.49	1 99	3.27	2.31	1.47	0.90	0.79	0.56	17.15	13.72	
Av. No. days with precipitation		2	2	2	4	6	6	7	6	4	3	3	3	47	33	10
Av. snowfall, in.		2.6	5.7	2.4	2.6	0.4	0.0	0.0	0.0	0.2	0.3	3.4	6.4	24.0		9
Temperature—																
Mean		36.3	37 0	43.2	53.2	60.9	64.3	73.2	73.3	69.9	53.2	45.3	34.1	53.4		9
Mean Max.		49.2	52.8	58.4	69.0	76.2	84.7	86.5	87.9	81.7	70.2	60.8	43.3	68.4		
Mean Min.		23.4	21.3	27.2	37.3	45.4	55.6	59.8	58.7	47.4	41.6	26.8	20.0	38.7	....	9
Highest		73	79	80	89	99	100	102	100	97	89	83	76	102		9
Lowest		–2	–18	0	13	22	34	41	42	32	16	2	–5	–18		9
Prevailing wind		W	W	W	SW	SW	SW	SW	SW	SW	W	W	SW			9
Days clear		20	19	18	17	18	18	17	17	21	23	22	19	229	108	10
Days partly cl'dy.		9	6	10	9	10	11	12	13	7	4	5	8	104	62	10
Days cloudy		2	3	3	4	3	1	2	1	2	4	3	4	32	13	10

Frost—Average date of first killing frost in autumn, Oct. 18.
Average date of last killing frost in spring, Apr. 21.
Earliest date of killing frost in autumn, Oct. 7.
Latest date of killing frost in spring, May 7.
Average length of growing season, 180 days.
Years recorded, 10.

*Estimated from nearby stations.

This is a northeast border county, largely a rolling, somewhat broken prairie of moderate altitude (5,000 feet), but increasing in the northwestern part to 6,000 and 8,000 feet in the mountains. There are a number of canyons and creeks which supply shelter and water to livestock. There is, however, no very large variation in precipitation, which averages 16 to 18 inches. Winds are prevailing southwest to west and fresh; high at times because of the open character of the southern and eastern portions of the county. Much clear weather occurs. The growing season is fairly long.

Average annual precipitation, 16 to 18 inches.
Average seasonal precipitation, 12.5 to 15 inches.
Average seasonal snowfall, 12 to 24 and 30 inches.
Mean annual temperature, 52 to 57 degrees.
Mean summer temperature, 70 to 76 degrees.
Mean winter temperature, 35 to 38 degrees.

Practically all of the farming is done under dry land methods, the principal crops being corn, kafir, milo, feterita, Sudan grass and broom corn, which are grown mostly in the southern and eastern parts of the county; and wheat, rye, barley and oats, which are grown more in the northern and western parts. Melons, squash and pumpkins may be satisfactorily grown under dry farming methods. The New Mexico Pinto bean is one of the principal cash crops; and in 1917 Union County planted a larger acreage of beans than any other county in the state. Wherever water for irrigation can be had large yields are obtained of alfalfa and other crops. Irish potatoes do well in many districts and are considered to be one of the coming crops of the county. In the higher elevations in the northwest corner of the county the potato has done well for the past eight or nine years. Since then it has been tried with more or less success in all parts and at all elevations. However, it is not recommended to be grown on a large scale.

Stock raising is extensively carried on, and many cattle, horses and sheep are raised on the natural grass of the plains and mountains.

VALENCIA COUNTY

STATION—LAGUNA. APPROX. LATITUDE—35° 02′. LONGITUDE—107° 24′. ELEVATION—5,840 FEET.

	Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual	Seasonal	Record, Yrs.
Precipitation.....	1849	....	....	....	....	....	....	....	.....	....	.....	....	0.40	......	....	...
	1850	0.45	1.10	0.63	0.55	0.23	0.28	0.85	0.26	1.37	1.58	0.55	1.84	9.69	3.54	
	1851	0.15	2.11	0.10	0.94	0.01	.0	0.25	2.18	5.82	1.60	0.81	1.15	15.12	9.20	
	1905	...	...	...	2.62	0.60	1.30	0.73	0.25	1.25	0.50	3.40	5.40	......	6.75	
	1906	0.03	0.37	*T.	0.45	0.37	*T.	2.75	1.26	2.96	1.33	1.03	2.50	13.05	7.79	
	1907	0.87	*T.	0	3.00	0.25	1.70	1.40	*3.15	*T.	*1.50	0.20	0	*12.07	9.50	
	1908	*T.	0.60	0.40	1.60	*T.	0.15	3.55	0.70	0.25	*T.	1.10	0	8.35	6.25	
	1909	0.13	T.	3.10	0	T.	0.10	1.45	3.25	1.40	T.	0.45	0.72	10.66	6.20	
	1910	T.	0.49	0.09	1.21	0.50	0.20	0.87	1.63	1.95	1.64	0.98	0.12	9.08	6.36	
	1911	0.12	1.70	1.53	0.82	0.15	T.	6.26	0.70	1.20	0.08	0.16	6.18	12.90	9.13	
	1912	0	0.36	0.36	T.	T.	0.80	3.30	1.50	T.	1.25	0	0.56	8.47	5.60	
	1913	0.60	1.09	0.25	T.	0.50	1.35	T.	0.35	2.15	0.85	0.28	1.26	8.68	4.35	
	1914	T.	0.20	0.32	1.35	1.25	4.70	4.75	2.79	1.05	1.68	0.10	1.27	15.44	11.19	
	1915	0.66	0.25	...	4.30	...	...	...	...	...	...	...	...	.....	....	
	1916	...	...	...	...	...	...	...	....	...	2.15	0.54	6.22	.....	....	
Mean...........		0.25	0.69	0.62	1.33	0.32	0.55	2.18	1.50	1.62	0.95	0.76	1.18	11.70	7.50	
Av. No. days with precipitation ...		1	2	1	3	1	1	5	3	3	2	2	3	27	16	12
Av. snowfall, in..																
Temperature																
Mean		33.8	37.3	42.6	52.3	59.6	66.2	74.5	72.5	65.4	52.3	41.9	30.8	52.4		12
Mean Max.		48.0	52.2	55.8	68.6	78.6	81.2	90.9	88.1	82.0	69.9	56.3	44.0	68.0		12
Mean Min. .		19.6	22.3	29.3	36.0	40.7	51.2	57.6	56.9	48.7	34.7	27.5	17.6	36.8		12
Highest		67	67	83	88	95	161	103	103	95	84	76	67	103		12
Lowest		–11	–12	0	19	22	30	46	42	26	18	7	–20	–20		12
Prevailing wind..		W	W	W	W	W	W	W	W	W	W	W	W	W	W	12

Frost—Average date of first killing frost in autumn, Oct. 9.
Average date of last killing frost in autumn, May 1.
Earliest date of killing frost in autumn, Sept. 22.
Latest date of killing frost in spring, May 15.
Average length of growing season, 161 days.
years recorded, 12.

*Estimated from surrounding stations. Average snowfall, inches, no data.

This is a western border county, extending, however, far into the central part of the state, with the Rio Grande crossing its eastern end from north to south; while the Rio Puerco and San Jose Rivers cross the northeast corner of the county. The altitude along the Rio Grande is comparatively low, but most of the county averages above 6,000 feet, rising in the Zuni Mountains in the northwest portion to 8,000 and 10,000 feet. There is in the central and western portions much broken, rough, lava strewn country. The precipitation is small along the Rio Grande, averaging about 10 inches, but increasing somewhat over the northern, central and western upland, mesa and mountain districts. Winds of the county are prevailing southwest to west and light. Much clear weather occurs, and a fairly long growing season. The precipitation, temperature, and other weather data given for Albuquerque, Bernalillo County, can be applied to the Rio Grande Valley conditions in this county.

Average annual precipitation, 9.1 to 14 inches.
Average seasonal precipitation, 7.5 to 12 inches.
Average seasonal snowfall, 8 to 15 or 20 inches.
Mean annual temperature, 52 to 55 degrees.
Mean summer temperature, 70 to 75 degrees.
Mean winter temperature, 34 to 35 degrees.

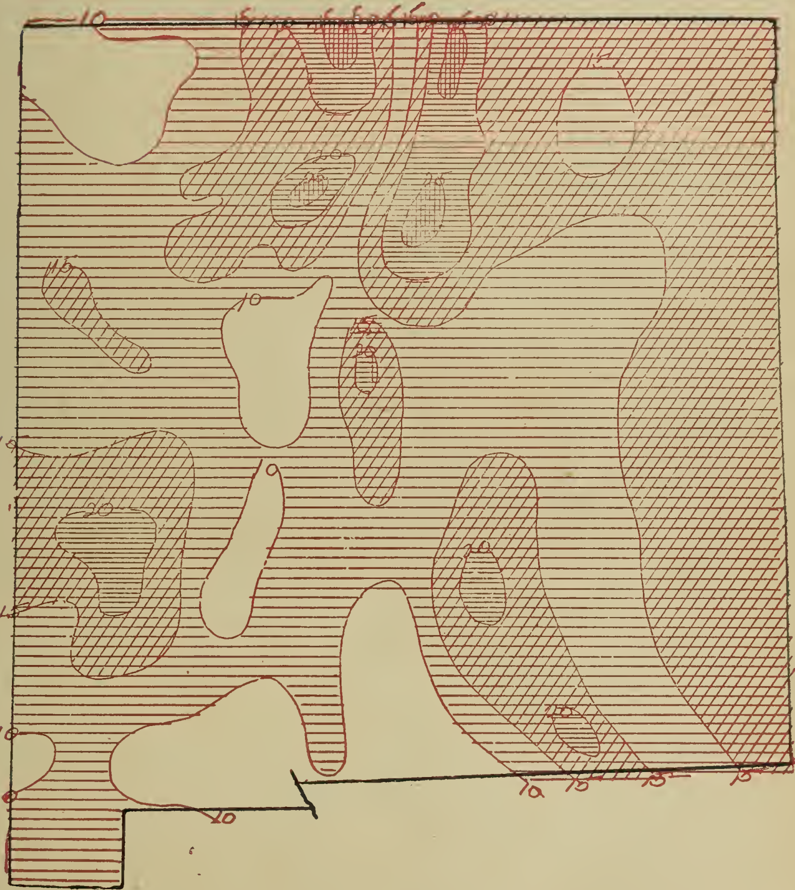
Practically all of the irrigation agriculture is being carried on in the Rio Grande Valley, and to a lesser degree in the San Jose and Rio Puerco Valleys, where alfalfa, wheat, corn, beans, chile, and onions are among the principal commercial crops; although oats, barley, sorghums, cabbage, tomatoes, beets, melons, carrots and many other crops can be successfully grown if desired. European and American plums, peaches, grapes (mostly the European varieties), apples and pears are among the principal fruits. In the western part of the county, wherever sufficient water can be had for irrigation, practically the same crops can be grown as in the Rio Grande Valley. In the high mountain districts, particularly the Zuni Mountains, where there is sufficient rainfall, the beans, short season corn, potatoes and oats are raised successfully. At altitudes of 7,500 feet and above the potato may be expected to do its best. In

the extremely high places such warm season crops as tomatoes, melons and chile should not be expected to produce good crops.

The large mesas, plateaus and mountain ranges afford good pasture for the grazing of livestock. Valencia County ranks second in the number of sheep grazed on its ranges.

NORMAL PRECIPITATION CHART FOR NEW MEXICO

FROM ALL DATA TO THE CLOSE OF 1917



SCALE OF SHADES—IN INCHES

Less than 10 | 10 to 15 | 15 to 20 | 20 to 25 | More than 25

SUMMARY

A large variety of crops can be raised in New Mexico. Practically all of the temperate zone crops and fruits are now being grown. Oftentimes, however, it is thought by people not familiar with the New Mexico climate that tropical fruits are raised in the state. This is not so; for although New Mexico lies pretty well to the south, the climate is not a tropical one, no doubt due to the high altitudes. Even the fig, which is a semi-tropical fruit and which is grown as far north as latitude 33°, principally in the lower Rio Grande and the Pecos Valleys and in the Tularosa basin, is not grown in the open. The best trees are to be found, as a rule, either on the east or south side of a building, or enclosed in some patio or corral; and from time to time these trees are winter killed clear down to the ground. The date palm has been planted at the Experiment Station; and while it has grown quite well during the summer, invariably it has been winter killed. Even such trees as the eucalyptus and the California pepper tree are not hardy enough to withstand our winter temperatures.

The moisture and temperature factors are undoubtedly the principal ones in the range of adaptability of a large number of vegetables, fruits and field crops. Most of the cool season as well as a large number of the warm season crops, including corn, beans, wheat, barley, sorghums such as milo, kafir and feterita, broom corn, apples, pears and peaches, as well as the different kinds of vegetables, may be grown, provided there is sufficient moisture to develop the crop. All of these crops, including alfalfa, are successfully grown under irrigation in the lower and warmer districts.

In the higher and cooler parts of the state the number of varieties of these different crops is materially reduced, and the short season varieties are more dependable. For example, tomatoes, chile, melons, long season corn and some of the sorghums are not grown successfully in the higher altitudes. The native beans, short season corn, oats, wheat, barley, potatoes and apples are among the principal crops raised in these altitudes, both by irrigation and dry farming methods.

In the lower dry farming districts beans, corn, sorghums, broom corn and wheat are among the principal crops.

According to the 1917 Crop Report, from the Department of Agriculture, beans were grown, both under dry farming and irrigation, in every county in New Mexico. Union County reported the largest acreage, with Mora a close second. Thirteen counties, mostly the eastern and southern counties, had over a thousand acres each of kafir, milo, feterita and sorghums; Curry reporting the largest acreage, with Roosevelt second. Every county produced large yields of corn, Union County reporting the largest acreage, while Mora was second. Nine counties produced a crop of broom corn, Union County reporting the largest acreage, with Roosevelt and Quay second. Twenty-five, or all but three counties, grew spring wheat, San Miguel reporting the largest acreage, with Doña Ana second. Twenty-two counties grew winter wheat, Mora reporting the largest acreage, with Curry second. Ten counties produced oats, San Miguel reporting the largest acreage, with Rio Arriba and Otero second. Twenty counties grew Irish potatoes, McKinley County reporting the largest acreage, with San Juan second. Alfalfa is raised almost altogether under irrigation. Fourteen counties are the alfalfa producers, Doña Ana and Chaves reporting the largest acreage. Apples are produced in twenty-two counties, Chaves reporting the largest acreage, with San Juan second.

Such crops as alfalfa, fruits and vegetables are not very dependable under dry farming conditions; and caution should be used in planning to grow these crops under such conditions. The Irish potato is a crop that is not dependable in most of the lower and warmer agricultural parts of the state. Consequently it is not advisable at the present time to attempt to grow this crop, at least on a large scale, in these localities. While the vines grow large enough, the yield, as a rule, is not satisfactory. The best potatoes are generally to be found at altitudes from 7,500 feet up, though occasionally in a few restricted districts lower than this, as in the Manzano Mountains, in Torrance County; in and around Dedman and a few other places in Union County; at Farmington and Aztec in San Juan County; and at Hope, in Eddy County, they are giving fairly satisfactory results. Before planting potatoes, however,

study carefully the climatic and soil conditions in the locality, so as to avoid making a mistake in growing this crop.

Since moisture is probably the principal factor in crop production in New Mexico, farmers intending to grow any crop under dry land conditions should study thoroughly the precipitation table* given in this bulletin for the different localities; and if these results do not apply to the particular locality in question, it is desirable to find out, as nearly as possible, whether the rainfall for that locality is greater or less than for the nearest station in that neighborhood. If in doubt it is suggested that you consult with the County Agricultural Agent, the Experiment Station, or the Weather Bureau. In a general way, however, it can be kept in mind that the lower valleys are dry (averaging from six to ten inches annually), and that agriculture is precarious without irrigation. Precipitation increases with altitude, and also somewhat from west to east; especially is the latter true east of the Rio Grande. The mountain areas, of which there are many, have much greater precipitation than the lowlands and valleys, and are thus the great natural reservoirs, or storehouses, of rain and snow, from which flow the streams that afford irrigation for the valleys. In the mountains the precipitation increases rapidly with altitude, amounting to 18, 20, 25 and even 30 inches annually over the highest peaks. It should also be kept in mind that over the northern mountains, especially, heavy snows and long, cold winters occur.

As a further limiting factor, temperature is probably second only in importance; and since, as a rule, it is lower with increasing altitude, the farmer or ranchman should be careful to adapt his cultural methods and varieties to the temperatures which prevail. Herein will the information given throughout the bulletin be of especial value. Again the very great diversity of contour should cause the prospective farmer or ranchman (and especially the orchardist) to consider carefully his location.

The cool season plants, such as cabbage, peas, onions, beets, and crops of that nature, will stand considerable cold; while the warm

*The "T." in the table stands for "trace," that is, not sufficient precipitation to be measured.

season crops, such as tomatoes, corn, sorghums, beans and melons, are very susceptible to frost injury.

In the case of the fruits, on the whole the apples and pears seem to be more resistant than the peaches and apricots. At the Station it has been found that the peach is least resistant to cold when it is about the size of a pea, when the calyxes are falling off. In a number of cases a temperature of 26 degrees, lasting only a short time, did little or no injury to the opening buds, newly opened flowers or newly set fruit of the peach, native plum, pear and apple.

The amount of injury done by the spring frosts to any crop will depend largely upon the stage of development of the plant, the degree of killing temperature, the time of day at which it occurs, and the length of time the temperature remains below the danger point. The longer the time the killing temperature remains and the nearer it is to sunrise the greater the amount of damage that should be expected.

The weather Bureau instructions give the following in regard to frosts:—

"Frosts will be designated as light, heavy, or killing. The term light signifies no destructive effect, except possibly to tender plants and vines; heavy, a copious deposit of frost, but which does not kill the staple products of the locality, and killing, frost that is destructive to vegetation and the staple products. The character of the frost, whether light, heavy or killing, must sometimes be determined by the phenomenon itself, rather than by its effect on vegetation and the staple crops, since the latter may have passed the stage where injury was possible."

Particular care should be taken in the selection of varieties of the different kinds of fruits, since many of them are susceptible to frost injury in the spring. This is true especially in regard to peaches, Japanese plums and apricots, which are among the earlier blooming fruits. Even the late blooming fruits, such as pears, apples, European and American plums and cherries, in many districts, are frequently partially or totally destroyed by the late spring frosts. Too much promiscuous planting has been done in the past with the different kinds of fruits; and on account of it many of the planters have been disappointed. The selection of the proper variety suited to the local conditions, particularly as regards the *blooming period,* is one of the most important considerations in the planting of fruit trees.

Closely allied with the temperature is the length of the growing season, or the period between the last killing frost in the spring and the first killing frost in the autumn. Data have been given for each county, and these may be taken to indicate this limiting factor. In a general way, however, it may be said that frosts will cease in the spring about April 1 below 4,000 feet; about May 1 below 6,000 feet; and by June 1 below 8,000 feet. The San Juan Basin, however, will be found to be somewhat later; and, on the other hand, many of the mountain valleys will be earlier than their altitude would indicate.

ACKNOWLEDGMENTS.

Acknowledgment is due the County Agricultural Agents in each county, for valuable suggestions, and for reading the write-up for the respective counties; and to Dr. R. F. Hare, Field Agent, Bureau of Crop Estimates, for valuable suggestions regarding the acreage of the different crops reported from the counties in 1917.

B

BULLETIN NO. 114
July, 1918

NEW MEXICO COLLEGE OF AGRICULTURE AND MECHANIC ARTS

Agricultural Experiment Station
State College, N. M.

Feeding Yucca on the Jornada Range Reserve

Range Cow Maintenance on Yucca and Sotol

BY LUTHER FOSTER AND CLEVELAND W. HUMBLE

NEW MEXICO AGRICULTURAL EXPERIMENT STATION

BOARD OF CONTROL

Range Cow Maintenance on Yucca and Sotol

Introduction

OWING to the overstocking of the ranges and the not infrequent drouths of the Southwest, stockmen in this region have for years been seeking some native plants, inured to the climate not ordinarily considered a stock food that would help out these conditions. The experiments in this direction have already shown the value of some varieties of the cactus for this purpose. The investigations of this Station, conducted by Professor R. F. Hare a number of years ago, both at this institution and at San Antonio, Texas, in co-operation with the United States Department of Agriculture, showed the composition, digestibility and food value of the cactus, and developed new methods of handling and feeding it. The results of this investigation are published in Bulletin No. 60, "Prickly Pear and Other Cacti as Food for Stock," by D. Griffiths and R. F. Hare.

While the cactus is widely distributed, it does not grow in sufficient quantities, except in very limited areas, to make it generally available for stock feeding. Then, too, it is quite difficult to handle and prepare for feeding, excepting on the land where it grows.

Sotol has also been quite extensively and successfully used for feeding in localities where it grows abundantly.

Further search for a range grown food that produces more abundantly than the cactus, and, at the same time, has a more extensive distribution, called attention to the possibilities of the different varieties of the Yucca; more particularly to the one commonly known as Amole or Soapweed (*Yucca elata*). Stockmen have long considered this an important plant on the range. At certain periods of the year, when the bloom stalks are growing, the cattle live on them, eating the stalk in preference to other forage. Often range cattle have been maintained almost wholly on these stalks through the period which they lasted. It was noticed, too, that they came to the watering places less frequently

Fig. I. Yucca slats before and after cutting.

while feeding on the Yucca. These facts, taken in connection with the chemical analysis of the plants, indicated their succulence and food value, and were instrumental, to a large extent, in the inauguration of the experiment.

A few years ago Mr. C. T. Turney conceived the idea of making use of the whole Yucca plant for feeding at times when the range was short. He constructed a pit silo on his range and filled it with Yucca, about three years ago, but did not feed it out until recently, when it was found to be in good condition, and the cattle ate it with relish. When the drouth came on last season it was very largely through Mr. Turney's efforts that a suitable machine was manufactured for cutting this plant at moderate cost and putting it in shape so that cattle could readily eat it.

The value of Sotol heads for cattle feeding is generally pretty well known. It is readily prepared for feeding, and has been quite generally used in western Texas to supplement the range when other feeds were scarce. Its compact head and general appearance gives better indications of food value than that of the Yucca. It was, therefore, included in the experiment as a means of comparison. It is not nearly so important a plant as the Yucca, because of its less wide distribution, being found, as a rule, only on the foothills and slopes near the mountains, while the Yucca is pretty generally distributed over the mesas extending from the valley to the mountains over such areas as seem adapted to it.

Yucca elata (Soapweed) is the variety used in this experiment; but, judging from analysis recently made, it is believed that the *Yucca macrocarpa* (Spanish Dagger) will prove equally good, and it is distributed practically over the same area as the *elata,* and is often mixed with it. Another species of this plant, known as Bear Grass (*Yucca glauca*), has also been used for cattle feeding to some extent in the eastern portion of the State, where it is plentiful.

DESCRIPTION OF YUCCA SPECIES AND SOTOL

The following descriptions of these plants are taken from Bulletin No. 87 of this Station, which was written by Professor E. O. Wooton, formerly Botanist of this institution.

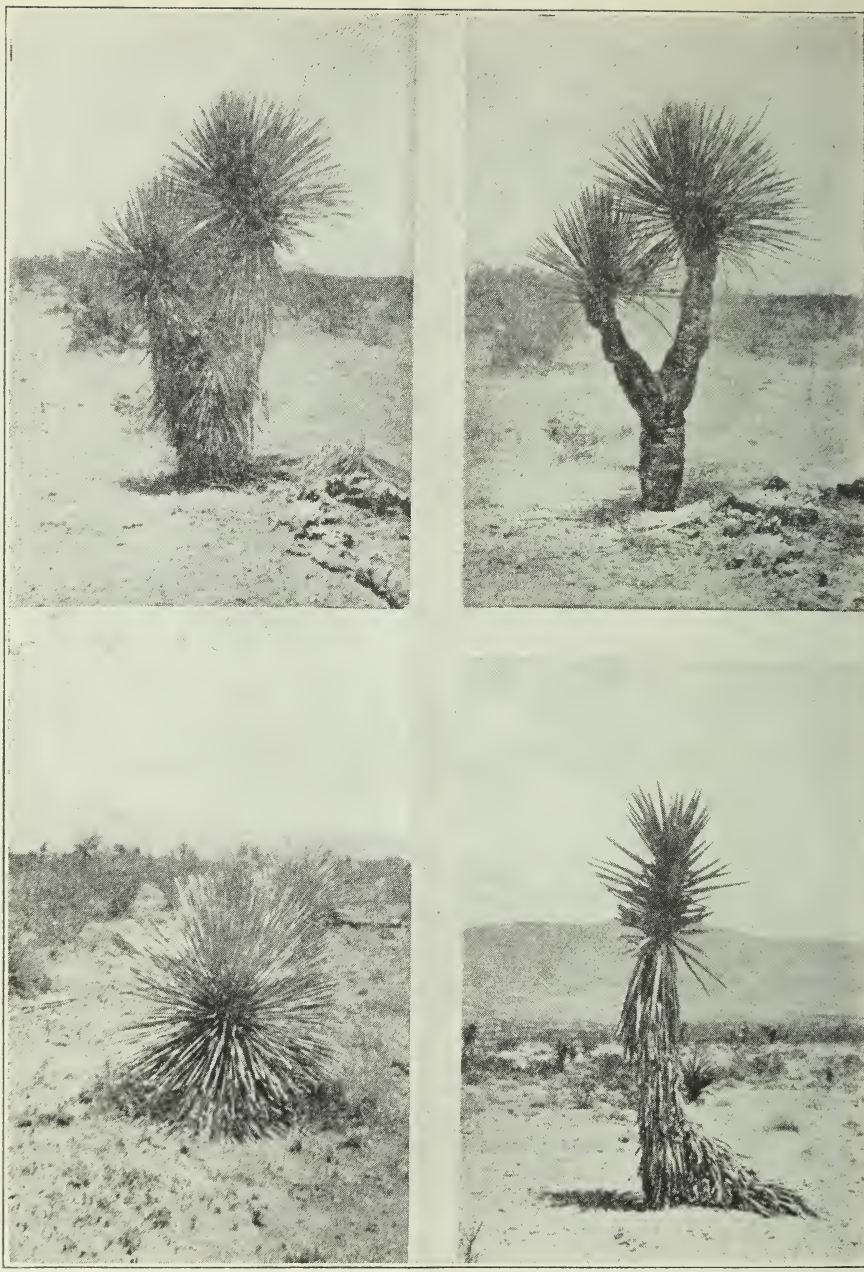


Fig. III. Yucca before and after burning.
Yucca too small to cut and Spanish Dagger.

Soapweed, La Palmilla, Amole (*Yucca elata*). This is the tall, narrow leaved species of Yucca. Its leaves are slender (half an inch wide or less), flexible, and very numerous; its flower-stalk is much taller, its blooms make a better showing than the other varieties, and its stem is more often branched. Its stems are conspicuous (except in young plants), reaching a heighth of 10 to 15 feet in old plants, often several together in a cluster, simple or branched. Its leaves are in a cluster at the top, the lower ones reflexed; old dead ones sheathing the stem almost to the base. Its flower-stalk is a tall, widely spreading panicle 6 to 10 feet high, with numerous flowers, usually ivory white.

Spanish Bayonet, Spanish Dagger, La Palma (*Yucca Macrocarpa*). This is the broad and stiff leaved species which is common on the mesas in the southern part of the State. Ordinarily it has a straight stem six to eight inches in diameter and four to eight feet high, with a head of stiff, spreading leaves about four feet in diameter at the top. Under favorable conditions this plant will reach a height of 18 or 20 feet. The stem is usually simple, but sometimes it branches either at the base or some distance from the ground. The leaves are rigid, rough like shagreen, yellowish green, not glaucous; filaments coarse and grayish.

Bear Grass (*Yucca glauca*) is exceedingly common in the eastern part of the State; and on much of the land now used as dry land farms it was necessary to grub these plants out. By the residents it was considered as an undesirable weed. It resembles the soapweed very closely, but is almost stemless and the panicle of flowers is shorter and much less branched.

Sotol (*Dasylirion wheeleri*) is a perennial, with flat strap-shaped leaves having numerous recurved slender teeth along the margin. The trunk is usually 6 or 8 inches in diameter and from 1 to 4 feet tall, and covered by the dead leaf bases of older leaves. The leaves are very numerous and flexible, forming a thick crown at the head of the stem. The flowers are very small and numerous, borne in panicles on a tall stalk, often several feet high. It is a near relative of the Yucca and is usually found more or less associated with it. It usually grows among the rocks on the foothills and mesas, near the mountains.

The bases of the leaves form a round head (when the ends have been cut off), which has been used extensively for stock feeding in western Texas. These heads are roasted by the native people and used for food, and for the manufacture of a drink, also called Sotol, which contains from 40 to 50 per cent of alcohol.

Fig. IV. The large type Yucca cutter in action.

Plan of Experiment

The object of this experiment was to determine the value of Yucca and Sotol for maintaining range cows through periods of drouth like that just past, when the ranges are either bare or very short of anything upon which cattle may graze.

For this feeding test twenty-five range cows in thin condition from two to four years old, were selected. Five of them had calves by their sides when the experiment began. The other twenty were divided into four equal lots, one of which was fed 25 lbs. per head daily of Sotol heads, which was later increased to 30 lbs.; another the same quantity of Yucca. The other two lots were fed exactly the same as the preceding two, with the addition of 2 lbs. of cottonseed meal per head daily, but with no increase in the quantity of Yucca or Sotol. The five cows with calves were made a separate division, and were given 25 lbs. of Yucca and 2 lbs. of cottonseed meal per head daily, throughout the test. The calves were allowed the run of a separate lot, where they were given a small allowance of Yucca and cottonseed meal, which was gradually increased until the cottonseed meal reached one-half a pound per head, with about all the Yucca they would eat. Ten additional calves were dropped during the experiment, which were also given the run of the calf lot as soon as old enough to eat, and the quantity of feed was increased proportionately.

The lots contained five cows each, and were arranged and fed as follows:

Lot I. Sotol heads, 125 lbs. daily.

Lot II. Sotol heads, 125 lbs. daily and 10 lbs. of cottonseed meal.

Lot III. Yucca (Soapweed), 125 lbs. daily.

Lot IV. Yucca (Soapweed), 125 lbs. daily, and 10 lbs. cottonseed meal.

Lot V. Cows with calves by side, fed the same as Lot IV, 125 lbs. of Yucca daily and 10 lbs. of cottonseed meal.

PREPARATION FOR FEEDING

During the first few weeks of the experiment both the Sotol heads and the Yucca were prepared for feeding by chopping them up into coarse pieces with an axe and then running the pieces through an en-

Fig. V. Sotol lots with and without cottonseed meal.

silage cutter. This preparation put the plants into good condition for feeding, but the process was too expensive to be practical. As soon as the new machines, designed especially for cutting the Yucca, were ready for use, one from each of two factories was contributed for demonstration and use in the experiment. Both of the machines did excellent work, cutting and shredding the stems and heads sufficiently fine for the cattle to eat them with very little waste; and they reduced the expense of cutting to a comparatively small item. The power used for running these machines was a 15 H. P. electric motor that had been installed at the College Farm some years ago for the cutting and grinding of feed.

Four different kinds of machines have been manufactured during the past year for the purpose of cutting up and preparing Yucca for feeding. Two of them were made in El Paso, Texas, and two in Deming, New Mexico. All of them did very good work, the general idea of all being the same—to prepare the Yucca so that it can be fed with little waste. Three of them had a tendency to cut and shred the plant at the same time, while the other one simply cut the stem into thin slices and broke hem up into fine particles. But the quantity rejected by the cows did not differ materially because of the different methods of preparation.

In preparing the Yucca for cutting the dry leaves were burned off of the stem of the plant where it grew on the mesa. It was then cut off at the ground, the stem furnishing the most important part of the feed. The green leaves of the top were not eaten with the same relish as the slices of the stem unless cut up fairly fine.

Only the compact head of the Sotol was used, the stem and leaves being cut off close to it. The brown, dead-looking leaves of the lower part of the head were also trimmed off.

HOW FED

In feeding the Yucca and Sotol, long, deep troughs were used; and where cottonseed meal was fed with either, the Yucca or Sotol was spread over the bottom of the trough and the meal was sprinkled over it. The cows were fed once daily, just before noon. They were eager for this feed from the first, and ate it with, seemingly, great relish. The cows used in the experiment were already familiar with cottonsed meal, but cattlemen in this locality who fed Yucca and cotton-

Fig. VI. Yucca elata lots with and without cottonseed meal.

seed meal during the past winter, suggest that a good way to teach the cows to eat cottonseed meal is to sprinkle it over the Yucca. In that way they eat it from the beginning, while it often takes several weeks to teach them to eat it when it is fed alone.

In addition to the feeds mentioned, the cows had the run of about fifty acres of brush pasture, consisting of what is known as *chamiso* or shadscale brush, with a few mesquite and creosote bushes scattered through it. In the beginning, when the Yucca and Sotol had a tendency to physic the cows, they ate the dry leaves and seeds of the brush quite freely, which had a tendency to counteract the loosening effect. This brush also had a tendency to satisfy their craving for dry feed, after the abrupt change from the very dry feed of the range to such succulent feed as the sliced Yucca made. It was the intention to make the conditions similar to those of the range, where the cattle would have some dry weeds, or grass in connection with the Yucca or Sotol. This brush pasture was pretty well eaten off within the first six weeks of the experiment, but later on in the season the cows were herded about three hours every day on a similar unfenced pasture, to determine if the seeds and leaves of this plant have any special food value or effect in maintaining the cows. There was a constant supply of water and salt in the pasture, to which the cows had free access.

These cows were put on feed December 11, and during the first month, when no regular machine was available for the preparation of the feed, all lots were fed Sotol about half the time, because it could be more readily prepared. The regular experiment did not begin until January 12, when each lot was confined to the special feed it was to have as shown by the outline of the experiment. No cottonseed meal was fed to any of the lots up to that time.

The following table shows the weights from time to time of the different lots of cows and the calves, from the fifth lot, during the experiment:

WEIGHTS OF COWS AND CALVES

Preliminary Period in Corrals

	Date	Lot 1 Sotol Only	Lot 2 Sotol and Cottonseed Meal	Lot 3 Yucca Only	Lot 4 Yucca and Cottonseed Meal	Lot 5 Yucca and Cottonseed Meal	Calves Lot 5 Yucca & Ctn-seed Meal
First weights	Dec. 11	3195	2995	3035	3015	2705	
Last weights	Jan. 12	3250	2995	3035	3140	2725	
Gains		55			25	20	

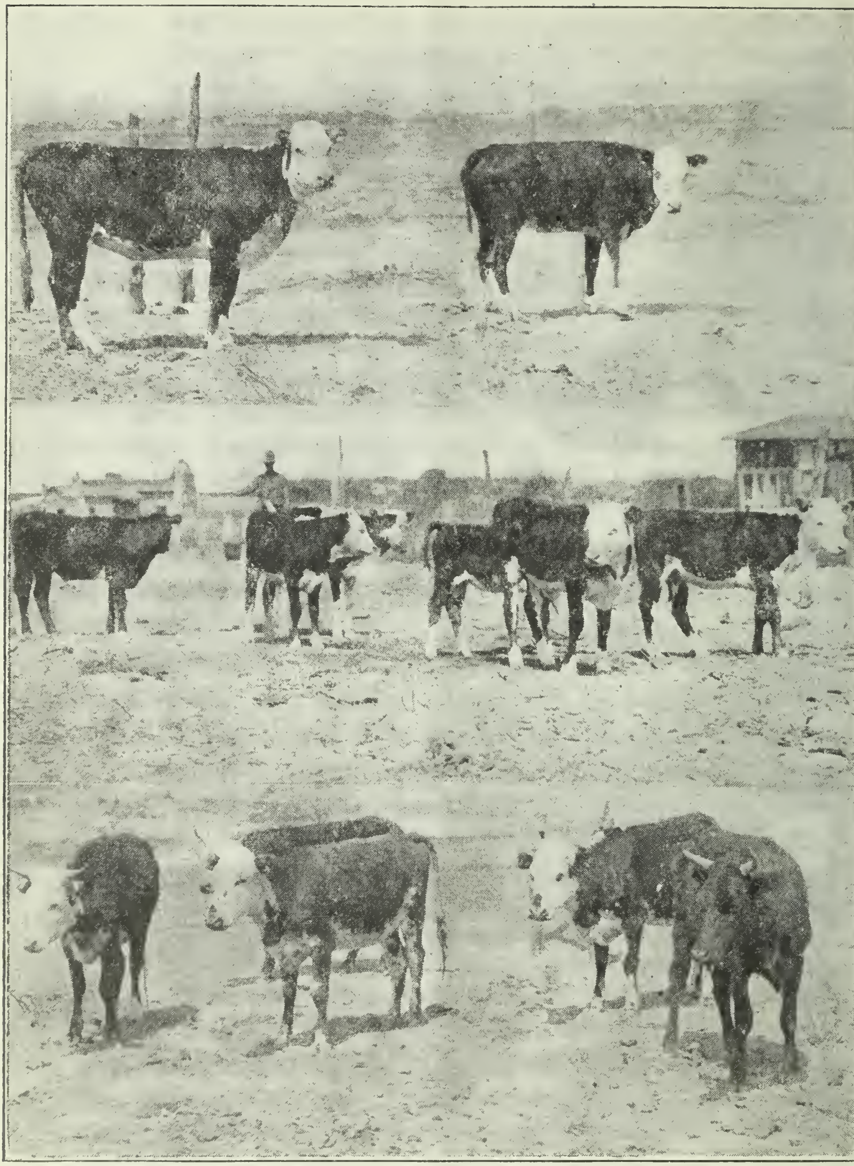


Fig. VII. Two cows without calves from Lot IV
Calves from Lot V and their Mothers.

First Period, on Brush Pasture

Beginning weights	Jan. 12	3250	2995	3035	3140	2725	515
	Feb. 12	3190	3265	3120	3545	2940	685
	Feb. 26	3215	3350	3115	3520	2905	745
	Mar. 12	2960	3245	3060	3460	2975	830
	Mar. 19	2937	3340	3020	3440	2950	885
	Apr. 2	2985	3290	2990	3425	3060	975
	Apr. 16	3060	3455	3060	3530	3045	1085
	Apr. 30	3075	3425	3020	3465	3050	1105
Ending weights	May 7	3060	3325	3055	3420	3005	1245
Gain or loss		190	330	20	280	280	730

Second Period, in Corrals

		5 cows	3 cows	5 cows	3 cows	5 cows	5 calves
Beginning weights	May 7	3060	1888	3055	2100	3005	1245
	May 21	2880	1790	2945	1950	2990	1300
	May 28	2975	1810	2915	1900	2945	1350
	June 13	3180	2340	2950	1830	2930	1490
Final weights	June 25	3150	3000	2900	3220	2860	1500
Gain or loss		10	325	155	200	145	255
Number of Calves		1	3	4	2	5	

NOTES ON TABLE

Lot I, fed on Sotol alone, and Lot III on Yucca alone, were carried on these feeds through the entire experiment without interruption, from January 12 to June 25. A very thin cow of the Sotol lot raised the only calf that came to that lot, but it was found necessary to feed her two pounds of the cottonseed meal per day for 38 days to keep the calf growing and put the cow in condition to live on Sotol alone.

Four calves were raised by Lot III, the cows having no other feed than the Yucca. Considering the fact that the first weights of the cows were taken before these calves were dropped, and the final weights without them, one may safely conclude that the cows were fully maintaind during the 6½ months' feeding trial.

Fig. VIII. Native field of Yucca. Method of cutting and loading.

Lot II, fed Sotol and cottonseed meal, and Lot IV, fed Yucca and cottonseed meal, were not only maintained but made very good gains during the first period; but in readjusting the experiment for the second period, two cows were taken from each of these lots for a digestion test, and they lost quite heavily from the close confinement and the withholding of the cottonseed meal. They were returned to their respective lots a short time before the final weights were taken.

All the cows of Lot V had calves when they came in from the range, and they not only raised their calves, but also improved much in condition during the first period; but during four weeks of the second period they were fed on Russian thistle silage without cottonseed meal, which accounts for their loss in weight.

It will be seen that the calves gained steadily all through the experiment, except at the very last, when their supply of milk was likely lessened by the change made in the feed of their mothers.

The whole quantity of feed given Lot I from December 11 to June 25 consisted of 1600 pounds of Yucca, 25,475 pounds of Sotol and 76 pounds of cottonseed meal.

Lot III had, during the same time, 25,475 pounds of Yucca, and, in addition, during the preliminary period, 1600 pounds of Sotol.

Lot V was given, during the same time, 20,650 pounds of Yucca, 3,775 pounds of Russian thistle silage and 1600 pounds of Sotol, in addition to 1150 pounds of cottonseed meal.

The five calves of Lot V were fed by themselves from January 12, and they were given 6670 pounds of Yucca and 536 pounds of cottonseed meal. The extra gains that were made, apparently from this extra feed, would no doubt well repay the outlay.

Composition and Digestibility

Professor J. D. Hungerfold, the Nutrition Chemist, determined the composition of *Yucca clata, Yucca macrocarpa* and Sotol heads. He also ran a preliminary digestion experiment to determine the digestibility of the *Yucca elata* and Sotol heads as used in the feeding experiment. The following table gives the results of the work:

PRELIMINARY DIGESTION TRIAL.

Composition in percentage.

	Air Dry Matter	Moisture	Ash	Protein	*Carbohydrates* Fiber	N. Free Extract	Fat
Sotol	26.00	4.90	4.53	3.59	25.00	59.59	2.39
Yucca elata	42.69	5.29	8.11	3.95	30.93	50.69	1.02
Yucca macrocarpa	32.8	5.58	7.46	4.69	32.84	48.13	1.30

Coefficients of Digestibility.

Sotol	39.68	35.50	81.05	2.81
Yucca elata	34.81	38.81	74.63	.00

Digestible Nutrients in 100 pounds of Fresh Material.

Sotol	.37	2.31	12.56
Yucca elata	.59	5.21	16.15

These analyses are reported on an Air-Dry Matter basis.

While this work is only preliminary, it gives a very good idea of the digestibility of these plants, and the results compare quite favorably

Fig. II. Mountainside of Sotol.

with our estimates published in Press Bulletin 301. These estimates were made from the digestibility of corn fodder, as reported in Henry's "Feeds and Feeding." It will be noticed that the coefficient of digestibility of fat is in either case practically zero. No explanation will be attempted for these until after further investigation.

Although no very complete investigation of the carbohydrates of plants of this nature has been made, it has been noticed that they are largely composed of simple sugar and therefore readily available.

Further study is now being made at this Station of the feeding value and digestibility of Yucca elata, and the results will be reported in the near future.

Feeding Yucca on the Jornada Range

The following report of the system followed in feeding Yucca to cattle on the range, and the cost of the same, was furnished by Mr. C. L. Forsling, who is in charge of the Jornada Range Reserve:

COLLECTION, PREPARATION AND FEEDING OF SOAPWEED UNDER PRACTICAL RANGE CONDITIONS ON THE JORNADA RANGE RESERVE

By C. L. Forsling

Grazing Examiner, U. S. Forest Service.

The operations in the collection of the soapweed plants, the preparation of the material ready for feeding, and the actual feeding to stock under range conditions involve:

1. Burning away the dead leaves from the soapweed stems.
2. Selection and cutting of the plants in the field.
3. Hauling from the field to the chopping machine.
4. Chopping.
5. Feeding.

Burning Away the Dead Leaves.—The first operation involves the burning away of the dry dead leaves. Their low nutritive value and high fiber content make this portion of the plant undesirable for use

as feed. The presence of the dead leaves also makes chopping more difficult since there is a tendency to clog the machine, so that removal seems advisable. This can best be accomplished by burning the dry portion on the plants as they stand in the field, providing there is not enough vegetation on the ground so that fire will spread. One man with a torch working ahead of the cutting and hauling crew can burn the dry portion from eight to fifteen tons of the soapweed plants per day. A simple and effective torch for burning may be made from a dead soapweed trunk 12 to 18 inches long, carried on an iron rod five or six feet long with a small hook at one end. Dry, dead trunks are plentiful, light and easily handled.

The dry leaves burn readily, and in a short time, leaving the green foliage at the top of the plants and the succulent stem of the plant uninjured. Burning can be done best on days when there is no wind or only light wind, as high winds often extinguish the fire before the dry portion is completely burned.

Where there is danger of fire spreading over the range, burning should be done after the plants have been hauled to some bare spot, preferably near the chopping machine, by scattering them on the ground and applying the torch. To avoid undue shrinkage in burning the plants should be placed in rows two plants wide, with the butts together and the green tops outside. This precaution prevents fire hot enough to burn the green leaves or succulent stem, and the shrinkage is about 30 per cent of the original weight. Where the plants are scattered thickly, burning results in the loss of about 40 per cent on account of the fire becoming hot enough to burn the green leaves.

Selection of Plants, Cutting and Hauling.—In the cutting during the winter and spring of 1918 on the Jornada Range Reserve, plants 36 inches or less in height were not cut, and occasional plants tall enough for the seed stalks to be out of reach of the cattle were left for shade and seed plants. The plants under 36 inches were left on the range, partly as a protection for the soil against wind erosion, partly because they will furnish considerable grazing until the growing tips, seed stalks and flowers are beyond the reach of the cattle, and in part because small plants cannot be handled in the feeding operations as economically as the larger ones.

The plants were cut at the surface of the ground with an ordinary axe. As the plants were cut they were loaded into a wide rack and ar-

ranged orderly, so as to make the most effective use of space and facilitate unloading.

Where feeding operations are on an extensive scale it will be found practical to keep a crew cutting and hauling continually. A crew of four men with two four-mule teams for hauling, can work to good advantage. One man acting as foreman can direct the operations, select the plants for cutting and burn off the dead leaves, if burning is done in the field. Two men with axes cut the plants and hand them up to a third, who arranges them on the rack and drives the team. A crew of this size can select, burn, cut and haul four loads, approximately eight tons of soapweed, per day, where the haul is not over 2½ miles.

Chopping.—At least two types of machines have been developed to convert the stems and leaves into feed. One is on the principle of the ordinary feed chopper, and cuts or slices the stem; the other machine is on the basis of the ordinary "wood hog," and shreds or tears the plant into particles small enough to be eaten readily by cattle.

The chopper consists of a heavy drum-like wheel 24 to 30 inches in diameter and 12 to 14 inches wide, with several knives on the circumference, which work against a cutter bar or bar of heavy steel on the frame of the machine. This wheel is mounted on a frame and is covered with a hood to prevent throwing of the cut particles of feed. The soapweed plants, after being lifted to the machine, are carried automatically over the cutter bar and the knives on the heavy wheel, which makes 250 to 300 revolutions per minute, chop the stem into particles resembling somewhat thin slices of pineapple.

Three men are required to operate this machine when run at full capacity. One man lifts the soapweed plants to the carrier of the machine, another places them in contact with the knives or feeds the machine, and another is necessary to clear the chopped feed away from the back of the machine. An additional man to assist at the various places will expedite the cutting.

The plants are fibrous and tough, so that the cutting wheel must be maintained at a high rate of speed. A 15 to 20 horsepower engine is required to operate successfully the larger machines first put on the market. These machines, when in proper order and when operated by experienced men, will chop 25 to 30 tons of soapwed per day.

The shredding machine consists of a heavy sheet iron box, approximately 16 inches wide, 16 inches long and 36 inches deep, with a small

drum set with numerous teeth-like knives at the bottom. The soapweed plant is placed on end in the box-like arrangement, and with a slight pressure from the hand of the feeder is forced to come in contact with the drum set full of teeth. This drum is rotated at the rate of 500 revolutions per minute, and the teeth, coming in contact with the soapweed plants, tear or shred them into small particles. This machine may be operated by two or three men, and requires an 8 horsepower engine to run it satisfactorily. The capacity is much lower than that of the larger machine.

Neither machine cuts the leaves of the soapweed extensively, but they are torn apart sufficiently for the cattle to eat them.

Mixing the Soapweed and Cottonseed Meal. The desired amount of cottonseed meal can best be mixed with the chopped soapweed by sprinkling the meal over the chopped soapweed as it is loaded into the wagon beds for hauling to the feed lot. This may be done by loading a layer of soapweed and then sprinkling the meal on top, continuing in successive layers until the load is complete.

Feeding.—The best results have been obtained from feeding the soapweed in troughs. It is possible to feed on hard ground, but at best this is wasteful. When cottonseed meal is fed the troughs are most efficient.

Troughs.—A substantial trough of the following dimensions was found very satisfactory in the feeding operations at the Jornada Range Reserve: Length 15 feet, width 4 feet, depth 12 inches. The troughs were made of 2 inch yellow pine lumber, with bottom "tongued and grooved" to retain the cottonseed meal. The bottom of the trough should be about 18 inches from the ground, with substantial legs at ends and middle, bolted to the sides and securely braced. This makes a trough of large capacity, that will minimize waste, and is high enough from the ground to eliminate most of the danger of weak cows being hooked into the stronger cows. One trough should be provided for 12 to 16 head of cattle, to give the best results in feeding.

Hauling the Chopped Feed.—A common wagon bed 14 to 24 inches deep can be used for hauling the feed from the chopper to the feed lot. An ordinary wagon bed 20 inches deep will hold 1400 to 1800 pounds of the feed, or approximately 20 pounds to the cubic foot, when lightly trampled into the wagon bed.

The chopped feed can easily be handled with an ordinary hay or manure fork. Two men can haul 10 loads per day with a team and wagon, or would be able to feed 1000 cattle per day at the rate of 15 pounds per head per day.

Cost of Soapweed Feeding.—The cost of the different operations in feeding the soapweed, not including cost of cottonseed meal, on the Jornada Range Reserve, was approximately as follows:

Burning, cutting and hauling a distance not exceeding 2½ miles from range to chopper:

1 Foreman and Burner at $1.66 per day	$ 1.66
3 Laborers at $1.50 per day	4.50
8 Mules (feed) at 50c per day	4.00
	$10.16

Capacity per day, 8 tons.

Cost per ton	$1.27

Chopping into feed:

1 Foreman at $2.00 per day	$ 2.00
3 Laborers at $1.50 per day	4.50
Fuel (Gas and Oil) at $4.50 per day	4.50
Repairs, etc., at $4.00 per day	4.00
	$15.00

Capacity per day, 25 tons.

Cost per ton	$0.60

Hauling from cutter to feed lot:

2 Laborers at $1.50 per day	$ 3.00
2 Mules at 50c per day	1.00
	$ 4.00

Capacity per day, 10 tons.

Cost per ton	$0.40
Total cost per ton in feed troughs	$2.27

This figure represents the cost after the men become familiar with the work. At first the cost was about $2.75 per ton. The item of wages includes board. The cost, of course, will vary under different conditions of cost of labor and supplies and distance for hauling the plants and the feed.

SUMMARY

Judging from the results of this single experiment, it is evident that cows may be maintained on either Yucca elata or Sotol heads without other feed, through long periods of drouth. No doubt if these cows had been put on feed while they were still in good condition, instead of being very weak and thin, they would have remained in practically as good condition as when put on the feed. But thin cows that need improvement, like those in the experiment, should be given, at least for a time, a small allowance of the cottonseed meal in connection with the Yucca.

Not a single cow or calf was lost during the experiment, and all of them went back onto the range the middle of July in as good or better condition than when they were put on the experiment. The ten calves that came during the experiment were all of good size, and normally strong and healthy. They made very good growth, equal to that of the average calf on the range during normal years. The other five, which came in from the range with the cows, were a very thin, half-starved looking lot when they arrived; but the effect of the regular feeding on their mothers' milk supply, in connection with the allowance of cottonseed meal and Yucca, which they soon learned to eat, started them to growing. They gained 985 pounds from the beginning of the experiment, January 12, to June 25, at a very small cost of feed, and were in fine condition when they went back to the range the middle of July.

The succulence of the Yucca and Sotol plants had a loosening effect in the beginning of the experiment, until the cows became accustomed to it, about the same as any silage would have if given as the only feed to stock taken off of dry feed. But this did not prove at all serious, and nothing was done to check it except giving the cows the run of the brush pasture, where the dry feed that they obtained tended to counteract it. The new growth in the spring, after the sap began to move, had no bad effect in this direction. Although we obtained our supply of Yucca every few days, fresh from the mesa throughout the blooming season, there was no perceptible effect from its use. Not a cow was sick or off her feed during the entire experiment, and none were constipated or showed any signs of the clogging of the digestive tract.

Mr. Turney fed two range steers on Yucca and cottonseed meal for a number of months, and when they were finally slaughtered for beef

the College veterinarian made a careful examination of the digestive tract, and found it perfectly healthy and normal in every respect.

With knowledge now available concerning the feeding value of Yucca and Sotol, and the methods of preparing and feeding them, even prolonged drouth conditions need not cause more than a small per cent of loss on the ranges where either of these plants is available.

ACKNOWLEDGMENT

The authors are under obligations to a number of men and companies for the assistance and advice given in connection with this experiment; and they hereby express their full appreciation of all they did to help make the work successful.

Mr. C. T. Turney, of the Jornada Range, furnished the cows, and was instrumental in having one of the first machines made for cutting Yucca placed at the disposal of the institution. He also gave advice on a number of points necessary to make the experiment comply most nearly with range conditions and give results applicable as nearly as possible to the range.

To Mr. C. L. Forsling, Superintendent of the Jornada Range Reserve, who kept exact and complete records of the Yucca feeding carried on by Mr. Turney on the Reserve, they are indebted for the very important practical report on the methods of handling and feeding and the cost of the same, which is made a part of this bulletin.

To Krakauer and Company of El Paso, Texas, they are under obligations for the use of two machines, one of each type, and especially for getting a machine to them in the early part of the experiment, when they were finding it very difficult to get the feed satisfactorily prepared.

They are also indebted to Messrs. Peterson and Sons of Deming, N. M., for contributing a machine of the cutting and shredding type, a machine largely used in the southwestern part of the State.

The demonstration made by Mr. Davies, showing the working of his machine, also manufactured in Deming, by the Davies Manufacturing Company, was very much appreciated.

The negative for the cut used on the cover page, and also those used for cut IV, and VIII, showing the large type of Yucca cutters and range views, were furnished by Mr. C. L. Forsling of the Forest Service, who took the views on the Jornada Range Reserve.

BOLETIN NO. 115

AGOSTO, 1918

Colegio de Agricultura y Artes Mecanicas de Nuevo Mexico

ESTACION EXPERIMENTAL AGRICOLA

STATE COLLEGE, N. M.

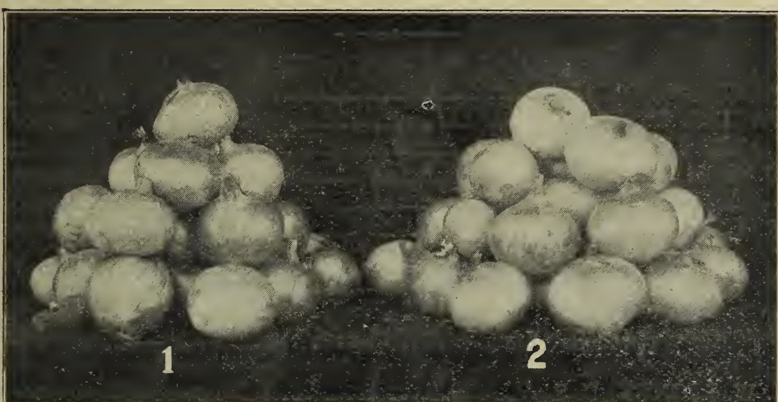


Lámina 1.—1. Variedad Gigantic Gibraltar.
2. Variedad Denia—Casi igual a la No. 1.
Trasplantadas el 18 de Marzo y cosechadas el 18 de Agosto.

LA CEBOLLA, EL AJO Y LA ESPINACA

POR FABIAN GARCIA

LAS CRUCES CITIZEN
1918

ESTACION EXPERIMENTAL AGRICOLA DE NUEVO MEXICO

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INTRODUCCION

Ahora, más que nunca, es sumamente necesario de aumentar la producción de los comestibles. Se les ha suplicado a nuestros agricultores por medio del Gobierno Federal y del estado, de sembrar más. La comida es tan importante para ganar esta guerra como son las balas. Se espera que ahora todos los agricultores estén de acuerdo que la comida ayudará mucho para ganar la guerra; y por lo tanto se debe sembrar más para aumentar la cosecha. Además de los productos que se pueden exportar, como el trigo, el azúcar y el frijol, necesitamos aumentar también el producto de los vegetales.

Los vegetales se dividen en dos clases, según sus requisitos al clima; aquellos que prefieren condiciones o estaciones frescas, y aquellos que deben de tener condiciones o estaciones calurosas para su mejor desarrollo. Entre la primera clase se incluyen los vegetales como la cebolla, chícharo, remolacha, zanhoria, col, apio, lechuga, ajo, chirivía, espinaca, nabo, esparragos y papas. Entre la clase segunda hay los vegetales como el chile, frijol, tomate, maíz, melón, sandía, calabaza y camote.

Los vegetales de estación fresca, por lo general, resisten algo el frío, y por esa razón se pueden sembrar en el otoño o mucho antes que el peligro del hielo se acabe en la primavera. En los lugares bajos y calurosos al sur del estado, como en los valles del Río Grande, Mimbres, Tularosa y de Pecos, donde el clima es caliente, es necesario sembrar estos vegetales temprano en la primavera, o aun en el otoño. En los lugares altos y más frescos y en donde el verano es más moderado y el invierno más frío, se pueden sembrar más tarde en la estación, porque las plantas crecen bien durante los meses de Julio y Agosto, madurándose a su debido tiempo, en Septiembre y Octubre. Las condiciones climatológicas siempre influyen el desarrollo de la planta, ya para mejorar o empeorar.

LA CEBOLLA

La cebolla, que es uno de los vegetales de mayor importancia, se puede cosechar en la mayor parte del estado donde hay agua para regar. Recuérdese que es muy difícil tener éxito con esta planta sembrada de temporal. Los resultados de los experimentos con la cebolla hechos en la estación experimental han sido muy favorables. En este clima la mejor cosecha se ha tenido cuando la semilla se ha sembrado en el otoño. Naturalmente que cuando la semilla no se siembre en el otoño se puede sembrar, con buen éxito, temprano en la primavera. En los climas de más altitud y más al norte, la semilla, por lo general, se siembra en el campo temprano en la primavera. Esto depende de las condiciones climatológicas locales; entre más frío el local, más tarde es la siembra.

SIEMBRA DE LA SEMILLA EN EL SEMILLERO

Si la semilla se siembra en el otoño para trasplantar en la primavera, la cama o el semillero, debe de arreglarse perfectamente, y el terreno debe de estar fértil. Por lo general, no se necesita cultivo ninguno durante el invierno; únicamente, hay que regarse varias veces. De dos a tres libras de semilla es suficiente para producir el cebollín necesario para trasplantar un acre de tierra. Cuando la semilla se siembra en el campo en la primavera, se requiere, por lo general, de cuatro a cinco libras de semilla por acre. Si la cebolla es de variedad grande las hileras se hacen de 15 pulgadas de una a la otra en las melgas; y si la variedad es chica, entonces las hileras tienen 12 pulgadas de distancia. Debe de tenerse mucho cuidado en no sembrar la semilla muy hondo. Si se siembra más que una pulgada de hondo mucha de la semilla no brotará.

FECHAS PARA SEMBRAR Y PARA TRASPLANTAR

Cuando la semilla se siembra en el otoño en camas friás o en semilleros de campo, las mejores fechas son del

25 de Septiembre al 10 de Octubre en climas como las que hay en los valles del Rio Grande, Mimbres, Tularosa y de Pecos al sur de Nuevo México. Si la semilla se siembra más temprano que el 25 de Septiembre, el cebollín crece mucho en el otoño antes de que haga mucho frío, y al siguiente año la mayor parte de la cebolla produce tallos y semilla. De lo contrario, si se siembra después del 10 de Octubre, entonces el cebollín no crece suficiente grande para cuando el frío comienza en el invierno, y muchas de las plantas quedan muy chicas y débiles para resistir el frío en pleno invierno. También no crece suficiente grande en la primavera para trasplantarse a las melgas a su debido tiempo, que es, en este lugar, del 15 al 30 de Marzo.

Siémbrese la semilla en hileras de 4 a 6 pulgadas de distancia de una a la otra, y de media a tres cuartos de pulgada de hondo en la cama fría o semillero. Inmediatamente después que se siembra la semilla debe regarse para que germine. Por lo general, el cebollín crece suficiente grande para cuando comienzan las heladas fuertes del invierno.

El cebollín resiste algo el frío. En varias ocasiones en la Estación Experimental el cebollín ha resistido la temperatura cuando ha bajado a zero.

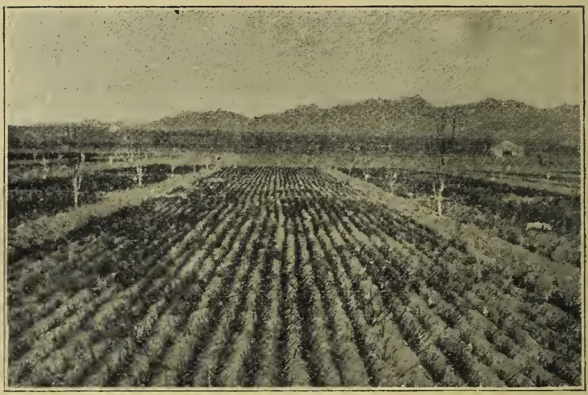

Lámina 2—Semilla Sembrada el 25 de Septiembre en el semillero en la Estación Experimental.

En los lugares bajos y calurosos se puede sembrar la semilla en las melgas en la primavera, cuando no se ha podido sembrar en el otoño. Esta es la costumbre general entre nuestros jardineros nativos. Siempre siémbrese la semilla tan temprano como sea posible, porque entre más tarde se siembre más inferior es la cosecha. Los resultados de las pruebas hechas en la Estación Experimental manifiestan que las siembras hechas del primero al último de Febrero han dado las cosechas más grandes. Las siembras hechas en Abril y Mayo han dado cosechas muy pequeñas. No se olvide que la cebolla requiere condiciones frescas para su mejor desarrollo. Por eso es que cuando la semilla se siembra tarde en la primavera o el cebollín se trasplanta tarde en los lugares bajos y calurosos del estado, la cosecha, por lo general, es chica e inferior.

En los lugares de más altitud y más al norte, donde el verano es más moderado y el invierno más frío, no se acostumbra sembrar la semilla en camas frías o en semilleros en el otoño para transplantar el cebollín en la primavera. La costumbre es de sembrar la semilla

en las melgas en el campo en la primavera. Por lo general, en altitudes de 5000 a 7000 pies de alto la semilla se puede sembrar del 15 de Marzo al 30 de Abril. En estos lugares el verano no es demasiado caluroso, y la cebolla crece perfectamente bien durante los meses de Julio y Agosto.

PREPARACION DE LA TIERRA PARA TRASPLANTAR

La preparación de la tierra para trasplantar el cebollín en la primavera es muy importante. Si esperamos levantar una buena cosecha, debemos de esforzarnos en arreglar la tierra tan bien como sea posible. Uno de los buenos modos de hacer esto es de regar la tierra primero, después ararla, arrastrarla y emparejarla. Hecho esto, las hileras deben rayarse. Las rayas se pueden hacer de una pulgada a una y media de hondo, por medio de una rayadora hecha a mano. El terreno no debe prepararse mucho antes que el cebollín se trasplante. Si la tierra se arregla con mucha anticipación, esta se aprieta mucho y se seca, y a la vez las hierbas crecen mucho, y por esta razón el trasplante de cebollín es mucho más dificultoso. Cuando la tierra está blanda y húmeda el trasplante se hace más pronto y con más facilidad. También, si la tierra está muy seca es más difícil trasplantar y se gasta más tiempo en hacer el trabajo.

EL TRASPLANTO

Los datos de los experimentos hechos en la Estación manifiestan que la cebolla da excelentes resultados cuando se trasplanta bastante temprano en la primavera, para que la mayor parte del crecimiento de la planta sea antes que lleguen los meses calurosos de Junio, Julio y Agosto. Muchos de los sembradores de cebolla aconsejan que el cebollín debería estar del grueso de un lápiz antes de que se trasplante. Esta es una buena regla. Sin embargo, no se debe confiar enteramente en ella. El tiempo de trasplantar el cebollín

es de mayor importancia en el desarrollo de la planta, y en nuestro clima frecuentemente el cebollín no está del tamaño de un lápiz para cuando se llega el tiempo de trasplantarlo. En este caso es mejor trasplantar cuando se llegue el tiempo, aunque la planta no esté del tamaño que se recomienda, mejor que dilatar el trasplante hasta que el cebollín haya crecido más grande. Los resultados de las pruebas que han hecho en la Estación con cebollín de la mitad del tamaño de un lápiz y aun más chico han sido muy satisfactorios.

Cuando se trasplantan grandes cantidades el trabajo debe hacerse lo más pronto posible. Suficientes hombres deben emplearse para poder trasplantar mucha cebolla pronto. Es buena idea que un muchacho vaya adelante de los trasplantadores, desparramando el cebollín. En efecto se puede trasplantar con más rapidez de este modo que cuando cada hombre lleva en las manos el cebollín, y cada vez que trasplanta una cebolla tenga que parar y sacar una de las que lleva en la mano. Si el muchacho trabaja con rapidez puede desparramar cebollín para tres hombres. Un hombre en un día de 10 horas puede trasplantar como cinco mil cebollas.

El cebollín es bastante fuerte para la sed, y puede durar todo el día sin regarse. No obstante, se recomienda que tan pronto como sea posible después de trasplantar, se riegue. El segundo riego debe darse de seis a ocho días después. Después que ya esté la planta creciendo, los riegos se pueden dar cada ocho a doce días.

Lámina 3—Los Hombres Trasplantando Cebollín el 9 de Marzo. Nótese la Zanjita que se ha Hecho para Trasplantar.

Lámina 4. Empaquetando Cebolla en la Estación Experimental para el Mercado

DISTANCIA A QUE TRASPLANTAR

Uno de los principales objetos en el cultivo de la cebolla es levantar una cosecha grande; y para hacer esto la tierra debe utilizarse ventajosamente. La mayor parte de los sembradores de cebolla en el valle del Rio Grande y otras partes del estado, ponen la cebolla muy separada una a otra. Generalmente la ponen cerca de doce pulgadas en cuadro, y de este modo la tierra no produce todo lo que debería. La distancia más común donde el método de cultivo es enteramente a mano, es de doce a quince pulgadas entre medio de las hileras, y de cuatro en las hileras. Cuando el cebollín se trasplanta a estas distancias, se puede poner un número grande, como de 100,000 a 120,000 o más por acre. Si el cultivo es por medio de caballo, entonces la distancia entre medio de las hileras tiene que aumentarse por lo menos a treinta pulgadas, y así se reduce la cantidad de cebollas por acre.

SIEMBRA DE LA SEMILLA EN LAS MELGAS

Esto se refiere a la siembra en el campo. Cuando la semilla no se siembra en el otoño en semilleros, entonces se puede sembrar en el campo en la primavera. Por lo general, los resultados de las pruebas que se han hecho en la Estación Experimental, a una altitud de 3800 pies arriba del nivel del mar, manifiestan que cuando la semilla se ha sembrado a principios de Febrero la cosecha siempre ha sido mejor. La cosecha de la semilla que se ha sembrado en Abril y Mayo ha sido inferior. En los lugares altos y fríos y en donde no se puede sembrar la semilla en el otoño, la siembra se hace temprano en la primavera. En los valles bajos y calurosos, del sur del estado, Febrero y Marzo son los mejores meses para sembrar; para el norte en lugares altos y fríos la siembra se hace como un mes más tarde, desde Marzo hasta fines de Abril.

Si la cebolla se va a cosechar por medio de trasplantarla o por medio de sembrar la semilla, las distancias de

una cebolla a otra en la hilera son iguales, lo mismo que las distancias de una hilera a la otra. El riego, el cultivo, la saca y el destallamiento son lo mismo. Por lo general, se requiere de cuatro a cinco libras de semilla para sembrar un acre en el campo cuando las hileras están de doce a quince pulgadas de distancia de una a la otra. Cuídese de no enterrar la semilla mucho; media a tres cuartos de pulgada de hondo es suficiente. Tan pronto como la semilla se siembre, debe de regarse para que germine. La semilla se puede sembrar a mano o con la sembradora de mano (Planet Jr. Seeder). Siémbrense las hileras derechas para poder cultivar mejor y más pronto.

EL TERRENO

La cebolla crece mejor en la tierra blanca y fértil. La tierra adobosa es muy dura, y se aprieta mucho después de regarse, y los bulbos no se desarrollan muy bien. Tierra arenosa no es muy buena para la cebolla, porque no es suficiente fértil, y en cuanto los tallos crecen bien los bulbos permanecen pequeños. La cebolla requiere un terreno muy fértil para producir una cosecha grande. Por lo tanto, siempre escójase la mejor tierra, y abónese si es necesario. La tierra conocida como "migajón" por los sembradores del Río Grande, es una de las mejores para la cebolla.

DESAHIJAR EN LAS MELGAS

Cuando la semilla se siembra en las melgas en la primavera, es necesario desahijar y dejar una planta cada cuatro pulgadas de distancia en la hilera. El desahije se puede trasplantar en otros lugares. Es muy necesario desahijar tan pronto como sea posible en la primavera, y mientras más temprano mejor. El desahije del cebollín es una operación muy costosa. El trabajo de desahijar y dejar a una distancia de cuatro pulgadas sin maltratar las raíces es algo lento y tedioso, y mucho

más si el cebollín ha salido tupido o en montones, y si la tierra está dura y barrosa. El cebollín se puede desahijar cuando esté poquito más grande que un fósforo. Por lo general, se requiere de siete a nueve semanas después que se siembra la semilla en la primavera para cuando se hace el desahije. Cuesta mucho más desahijar - acre de cebollín cuando la semilla se ha sembrado en las melgas que trasplantar la misma área.

EL CULTIVO

La cebolla debe crecer en una tierra fértil, suelta y húmeda. Para que la tierra esté suelta y blanda, se debe tener cultivada durante la sazón de vegetación. El cultivo de la cebolla es sencillo; consiste principalmente en tener la tierra húmeda, suelta y limpia. Si es posible, cúltivese después de cada dos riegos. Cuando el cultivo es enteramente a mano, se puede hacer muy ventajosamente con la cultivadora ''Planet Jr. Double-Wheel Hoe.'' Esta es la cultivadora que generalmente se recomienda para ese trabajo. Esta máquina no solo remueve la tierra, pero al mismo tiempo destruye la hierba entre medio de las hileras.

IRRIGACION

Aunque la cebolla es algo resistente, y puede durar uno a dos días sin regarse, es mejor que inmediatamente después que se trasplanta se riegue, y entre seis u ocho días volver a hacerlo. Se necesitan de dos a tres riegos para que las cebollitas tomen fuerza y empiecen a crecer, y el número de riegos subsecuentes depende de la clase de tierra y de las condiciones climatológicas. No obstante, parece que, para tener buenos resultados, la cebolla debería regarse cada ocho días, en los lugares bajos y calurosos. Ya que la cebolla toma su alimento de la superficie de la tierra, es muy necesario que ésta se mantenga húmeda y freca; así es que los riegos deben ser seguidos y solamente superficiales. No es buen método aplicar

mucha agua en cada riego. Las melgas deberían arreglarse de tal manera para desaguar toda el agua excesiva después de cada riego, especialmente en los terrenos adobosos. También se debe tener cuidado de que el agua no dure mucho en las melgas. Lo que es más necesario es tener la tierra húmeda uniformemente durante el desarrollo de la cebolla. Si la tierra se seca tanto que las plantas cesen de crecer, y luego se riega, puede resultar que muchos de los bulbos se rajen en dos o más partes. Cuando esto sucede, hay peligro de que la cosecha no tenga tan buen éxito.

LA COSECHA

Cuando las cebollas empiezan a madurarse, el riego debe cesar; y tan pronto como los tallos se ponen amarillos y se empiezan a secar, las cebollas deben cosecharse. Generalmente, las cebollas se maduran desigualmente y siempre quedan unas verdes, para cuando la mayor parte están listas para cosecharse. Es mejor cosechar las cebollas unos días antes, que después que todas se maduren. Si las cebollas se dejan algún tiempo después de madurarse en las melgas, especialmente cuando llueve, corren riesgo de que comiencen a crecer otra vez; unos cuantos días de retardo después que comienzan a crecer la segunda vez puede ser la causa de que muchas de las cebollas se echen a perder. La práctica de doblar o pisar los tallos al tiempo de madurarse, parece que induce a la cebolla a madurarse más igualmente.

Los tallos no se deben cortar hasta después que la cebolla no se ha secado y asoleado. Los tallos se pueden cortar con unas tijeras de podar; estas se prefieren a un cuchillo. Como media pulgada de largo del bulbo es bueno dejar el tronco.

Lámina 5— Cebollas asoleándose inmediatamente después de haberse destallado.

VARIEDADES

En el mercado se encuentran cebollas dulces como las variedades Denia, Gigantic Gibraltar, White Bermuda, White Pearl y White Queen; y las picantes, como las variedades Prize Taker, Australian Brown, Red Globe, Red Wethersfield, Yellow y Red Danvers. Las variedades dulces no duran mucho después que se han madurado, y por eso es necesario de venderlas pronto o almacenarlas en lugares frescos. Las variedades picantes son mejores para durar. Por eso es que en el invierno y en la primavera las variedades Australian Brown, Yellow y Red Danvers, y Red Wethersfield, etc., se encuentran en el mercado mucho más que las otras variedades.

Si se desea sembrar cebollas tempranas, la variedad White Bermuda es una de las mejores; la cebolla

Denia crece muy grande y es muy dulce, pero no tiene muy buen mercado localmente. (Véase Lámina 1). El mejor mercado para esta variedad se halla en las ciudades grandes, como Denver, Kansas City y Chicago. La variedad Brown Australian es una de las mejores para sembrar, porque es muy buena para durar y el mercado local la prefiere a las otras variedades. Esta cebolla se siembra muy a menudo al sur del estado. También las variedades Red Wethersfield, Yellow Danvers, y Prize Taker se siembran mucho en las partes del norte del estado, donde se dan muy bien. Procúrese conseguir la semilla temprano, para que se siembre a su debido tiempo en las diferentes altitudes y lugares del estado.

SEMILLA

La semilla de muchos vegetales está ahora algo escasa, y a la vez muy cara. Probablemente en muchos casos el jardinero pudiera provechosamente guardar suficiente semilla de cebolla para su propio uso. Esto se puede hacer con buen éxito. Los bulbos de la cebolla se pueden trasplantar en el otoño o en la primavera, según el local donde se hace el trabajo. En los valles calientes del sur del estado los bulbos se pueden trasplantar en el otoño, invierno y primavera. Para el norte del estado será mejor trasplantar los bulbos en la primavera, comenzando desde Marzo.

Siempre escójanse bulbos de los mejores para guardar semilla. Después de arreglar la tierra propiamente, los bulbos se pueden trasplantar de 4 a 6 pulgadas en la hilera, y tres pies entremedio de las hileras. El cultivo y el riego es igual que cuando se siembra la semilla. Por lo general, en los lugares bajos y calurosos del estado la semilla se madura para principios de Agosto; para más al norte para Septiembre y Octubre. Las pruebas que se han hecho en la Estación Experimental manifiestan que muy buenas cosechas de semilla se pueden producir.

Lámina 6—Semilla de la Variedad Denia, Cosechada el Primero de Agosto, en la Estación Experimental.

INSECTOS Y ENFERMEDADES

La cebolla, por lo general, la atacan pocas plagas. Hasta la fecha no le conocemos ningún chahuistle u otras enfermedades microscopias. La peor plaga que ataca a la cebolla es un insecto muy pequeño, los "thrips" (*Thrips tabaci, Lind.*) Este insecto también ataca otras plantas, como el ajo, la col, y el apio. Ultimamente en los valles bajos y calurosos de las partes del sur del estado los cebollales han sido algo perjudicados por este insecto. Cuando el insecto se presenta en grandes números es algo destructivo. Este ataca los tallos de la cebolla y les causa muchos lugares amarillosos que se nombra el "chahuistle blanco". Los "thrips" pertenecen a los insectos chupadores, los cuales recogen su alimento por medio de picar la corteza de la planta y chupar la sabia de los tejidos interiormente. Por esta razón este insecto no se puede atacar con ninguna mezcla venenosa, pero hay que atacarlo con una mezcla que mata por medio de bañarlo. Una de las mejores insecticidas que ahora estamos usando para los "thrips" de la cebolla es una solución hecha de la nicotina del tabaco, que se reconoce en el mercado como

''Black Leaf 40''. Esta insecticida es muy fácil para prepararla, y no hay peligro de quemar las plantas. Es muy fuerte, y hay que tener cuidado al hacer la mezcla de no aspirarla.

La fórmula de este baño es: una parte ''Black Leaf 40'' a 800 a 1200 partes de agua. Por ejemplo, una onza de Black Leaf 40, mezclada con 800 a 1200 onzas de agua es suficiente fuerte para matar el insecto cuando el trabajo de rociar se hace bien hecho. Hay que hecharle como cuatro libras de jabón disuelto a cada 100 galones de la mezcla. En cantidades pequeñas la siguiente fórmula puede usarse:

1 onza de Black Leaf 40
4 a 6 onzas de Jabón
6¼ a 9 1-3 galones de agua

Midan o pesen la onza de Black Leaf 40; pesen el jabón; revánenlo y pónganlo en la lumbre a disolver en una poca de agua. Cuando el jabón esté disuelto, calculen la cantidad de agua que tenga y hechen la demás agua necesaria con el Black Leaf 40 para hacer la mezcla, según la fórmula. Tan pronto como se haga la mezcla roceen las cebollas. Para hacer este trabajo se necesita una bomba de rociar, una manguera y un pulverizador. Si son pocas las cebollas, una bomba chica se puede usar; y si son muchas, una bomba grande es mejor. Por lo general, es mejor comenzar a rociar al momento que comienzan los ''thrips'' a atacar la planta y antes de que comiencen a multiplicarse. Al rociar las cebollas téngase cuidado de que la insecticida penetre el centro de la cebolla, porque allí es donde se encuentran muchísimos de los ''thrips''. Si la cebolla se trasplanta en la primavera, es buena idea de bañar el cebollín al trasplantarlo. De esta manera se pueden destruir muchos de los ''thrips''.

Lámina 7—Rociando las Cebollas para Matar los Insectos "Thrips" con Black Leaf 40.

EL AJO

El ajo pertenece a la misma familia de la cebolla; y se propaga por medio de bulbitos o "dientes." En los valles calientes del sur del estado el ajo se puede trasplantar en Enero o Febrero. En los lugares más altos y más fríos se puede trasplantar más tarde, como en Marzo y Abril. El ajo resiste mucho frío, y por eso es que se puede trasplantar temprano. Después de haber preparado la tierra debidamente, las hileras se deben de marcar y luego enterrar el ajo a una pulgada de hondo y 4 pulgadas de uno al otro en la hilera.

Después de trasplantarlo, se debe regar. El riego y el cultivo del ajo es igual al de la cebolla. La misma clase de tierra que es buena para la cebolla es buena para el ajo. En los valles calientes del sur del estado el ajo se madura para principios de Julio. En los lugares más altos y más al norte, se madura más tarde, porque también se trasplanta más tarde. En buen terreno y cuando se atiende propiamente, un acre de ajo debería de producir como 6000 libras. Recuér-

dese que es necesario siempre de procurar un terreno fértil. Si de naturaleza no está fértil el terreno, entonces abónese con buen estiércol.

ESPINACA

El Gobierno, al suplicarnos que comamos menos carne, azúcar y harina, no nos pide que hagamos ningún sacrificio; al contrario nos da la oportunidad de que cada uno de nosotros ayudemos a ganar la guerra; y a la vez nos conservaremos en mejor salud. Por lo general, la mayoría de la gente come su alimento demasiado sólido. Debemos comer más verduras verdes, como la lechuga, la col, el apio, y la espinaca. La sabia de estos vegetales contiene en solución ciertas sales e ingredientes minerales que son necesarios para la sangre, los nervios, huesos y dientes, los cuales ayudan a conservar la salud del individuo. Esto nos explicará porque es que en el invierno y en la primavera estamos deseosos de comer algo verde.

Acostumbremos a sembrar y usar más los tónicos de la naturaleza,—las verduras, "greens." Una de las mejores de esta clase de verduras, y fácil para cosecharse, es la espinaca. Sembremos más espinaca para comer algo de verdura en el invierno y primavera, porque esta es mejor verdura que las hierbas que les nombramos localmente "quelites."

Una hilera o melguita de espinaca sembrada en el otoño, invierno o primavera, según el local en donde vivimos, producirá suficiente verdura para el uso de la familia.

Lámina 8—La Semilla Sembrada en Melgas el 25 de Septiembre en la Estación Experimental.

La espinaca es una de las verduras que prefiere condiciones frescas para su mejor desarrollo, y a la vez es algo resistente al hielo; y por eso se puede sembrar en el otoño, invierno o primavera. En los valles bajos y calurosos del sur de Nuevo México, como los valles de Pecos, Rio Grande, Mimbres y Tularosa, la semilla puede sembrarse desde a principios de Septiembre hasta fines de Febrero. En estos lugares, cuando la semilla se siembra en Septiembre, muchas de las matas crecen suficiente grandes para comerse, antes que las heladas fuertes llegan en Diciembre y Enero; y para fines de Febrero, generalmente, la espinaca está suficiente grande para cosecharse y embarcarse. Las siembras tardes que se hacen a fines de Octubre, Noviembre y Diciembre, no crecen mucho durante el invierno, pero pronto se desarrollan las plantas en la primavera, cuando comienza el calor.

En los locales más al norte y de más altitud no se podrá sembrar la semilla en las fechas que se recomienda para el sur. Por razón de que el invierno es más frío y más largo en estos locales, será mejor sembrar la semilla tan temprano como sea posible en la primavera, como a

fines de Marzo y en Abril, dependiendo, naturalmente, de la altitud del local.

La espinaca es una cosecha que, por razón de que crece cuando muchas otras plantas no pueden crecer, no necesita mucho cultivo, más que regarse y probablemente una escarda. Para cuando la tierra necesita aflojarse y cultivarse en la primavera, ya la planta se ha desarrollado y se debe de cortar. Si la espinaca se deja crecer demasiadamente o hasta que eche flor, ya no sirve para comer. Por eso es que la mejor época de la espinaca es en el invierno y la primavera. Tan pronto como las plantas comiencen a echar el tallo y ponerse amarillas, debe el campo de ararse y sembrarse con cualesquiera otra cosecha.

La espinaca puede darse bien en muchas clases de terrenos, pero la tierra blanca o de "migajón" es de las mejores. Entre más fértil la tierra, más grande y mejor se da la planta. La espinaca requiere algo de nitrógeno para su desarrollo vegetal. La semilla se puede sembrar en melgas a nivel de la tierra o a un lado de camellones. Por lo general, los camellones dan mejor resultado únicamente que es poco más trabajo en hacerlos y en cultivar las plantas. Si se siembra en camellones, estos deben de hacerse de tres pies de distancia de uno al otro; y sembrar la semilla a un lado, generalmente, al nivel de donde llega el agua. Si la semilla se siembra muy abajo en el camellón, cuando se riega, las hojas de la espinaca se enlodarán, y esto le quitará mucho el valor para venderse en el mercado. Cuando se siembra la semilla en melgas al nivel de la tierra, se debe de tener cuidado al regar, para evitar todo lo posible, que no se llenen las hojas de tierra. Si se siembra en melgas, las hileras pueden estar de uno y medio a dos pies de distancia de una a la otra.

Una onza de semilla es suficiente para sembrar una hilera de 100 pies de largo. Téngase cuidado de no sem-

brar la semilla muy hondo. Por lo general, de ½ a ¾ de pulgada es suficiente hondo. Si la tierra está bastante húmeda cuando se siembra la semilla, no se necesita regar inmediatamente, pero, por lo general, hay que regar para que salga bien la planta. Si la tierra está seca cuando se siembra la semilla, entonces debe de regarse inmediatamente después. En algunos casos es necesario de regar dos veces, para que acabe de salir la planta. Esto depende de que tanto frío hace. Por lo general, cuando la semilla se siembra en Septiembre u Octubre, la mayor parte de ella brota en dos a tres semanas. En unas pruebas que se hicieron en la Estación Experimental con la espinaca la semilla se sembró el 25 de Septiembre en hileras, dos pies de distancia de una a la otra. Para el 21 de Febrero las plantas estaban suficiente grandes para cosecharlas.. La cosecha de una melga de 28,800 pies cuadrados produjo 3,120 libras de espinaca que viene siendo a razón de poco más que dos toneladas por acre.

Lámina 9—Nótese el Tamaño de la Espinaca el 21 de Febrero, cuando se comenzó a cortarla.

VARIEDADES

Como en todas las verduras hay varias variedades; unas se adoptan a ciertas condiciones mejor que otras.

No todas las variedades de las diferentes plantas dan iguales resultados en todos los lugares, y bajo de toda clase de condición climatológica. Es natural de toda planta de adoptarse o acomodarse a condiciones desfavorables o diversas. Si la planta se trasplanta o se siembra en lugares de condiciones diferentes a las que está acostumbrada, tiene que variar. En hacer esto, si la planta no se adopta a las condiciones nuevas, entonces se seca o no crece bien. Por eso es que hay que tener cuidado en el escogimiento de variedades de todas las plantas para las siembras.

Ya una vez teniendo informes sobre la adopción de las variedades a los diferentes locales no es difícil tener buen éxito con ellas si les ayudamos con el cultivo y el riego. Hay varias variedades de espinaca, pero entre todas ellas una de las mejores, especialmente para resistir el frío, es la variedad "Prickly" o "Winter". Esta variedad conviene sembrarla en los locales bajos y calurosos en el otoño e invierno; en los locales altos y más fríos, temprano en la primavera. Por la razón de que mucha de la semilla de la espinaca se importa de la Europa, este año va a estar algo escasa y cara. Por lo consiguiente, se aconseja que aquellos jardineros que siembren la espinaca este año procuren de conseguir la semilla cuanto antes.

SUMARIO

1. En donde quiera que hay agua para regar en Nuevo México, la cebolla se puede cosechar bien, pero no de temporal.

2. El cebollín para trasplantarse temprano en la primavera en los lugares bajos y calurosos del estado debe sembrarse en el otoño y el semillero debe tenerse bien regado durante el invierno.

3. Si todas las condiciones son favorables para el desarrollo de la planta, mientras más temprano se tras-

plante el cebollín en la primavera, mejores son los resultados.

4. Cebollín muy pequeño, como de la mitad del tamaño de un lápiz, se puede trasplantar con tan buen éxito como si estuviera más grande.

5. De las clases grandes pueden levantarse muy buenas cosechas en tierra blanda y fértil con solo el tratamiento ordinario.

6. Las cebollas que se guardan, es muy raro que se pudran, y la mayor parte de la pérdida resulta porque los bulbos retoñan.

7. El trasplante del cebollín no es más costoso que el desahijar en las melgas.

8. Los riegos deben ser frecuentes y superficiales en lugar de ser profundos y a largos intervalos.

9. Si la cebolla se riega después de suspender el crecimiento, especialmente si están los bulbos formándose, se induce un crecimiento enteramente nuevo en ciertas clases, que en veces resulta en ser perjudicial para la cosecha.

10. El agua no debe durar mucho en los lugares bajos de las melgas después de regar. Si es posible las melgas deben estar arregladas de tal manera que todo el agua que quede en las depresiones de las melgas se pueda desaguar.

11. Cultívese frecuentemente porque es muy necesario.

12. La cultivadora de mano "Planet Jr. double wheel hoe," cultiva la cebolla bien y el trabajo es satisfactorio; y es una máquina que evita mucho trabajo de brazos.

13. Parece que la cebolla se madura más igualmente cuando los tallos se doblan poco antes que se madura.

14. Abonos, especialmente en terrenos malos, aumentan la cosecha.

15. La tierra blanca y fértil es mejor que la adobosa o muy arenosa. La tierra que los agricultores del Río Grande le llaman ''Migajón'' es una de las mejores.

16. De 4 a 5 libras de semilla se necesitan para sembrar un acre de tierra a quince pulgadas de distancia entre las hileras.

17. El insecto ''Thrips'' es uno de los más perjudiciales a la cebolla, y se debe rociar con el ''Black Leaf 40'' a razón de una parte de Black Leaf 40 a 800 partes de agua y 4 partes de jabón.

18. Las variedades Brown Austrialian, Denia y White Bermuda se siembran muy a menudo en las partes del sur del estado. Las variedades Red Wethersfield, Prize Taker y Yellow Danvers producen excelentes resultados más al norte.

19. El ajo se parece mucho a la cebolla en cuanto a los requisitos sobre la mejor tierra, el cultivo, el riego, y las condiciones climatológicas. Por lo tanto, las instrucciones dadas para la cosecha de la cebolla se pueden aplicar, por lo general, para la cosecha del ajo.

20. Una onza de semilla de espinaca sembrada a ¾ de pulgada de hondo es suficiente para sembrar una hilera de 100 pies de largo.

21. En los lugares agrícolas para el sur del estado, la espinaca se puede sembrar desde Septiembre y cosecharse para fines de Febrero. Para el norte y en donde el invierno es más largo y frío es mejor sembrar temprano en la primavera.

22. La espinaca resiste mucho el frío y prefiere condiciones frescas para que cresca mejor. Nomás comienza el calor fuerte y se ''vuela'', es decir produce flor y ya no sirve para comer.

Todas las láminas en este boletín se han tomado de los boletines Números 52, 74, 82, y 92, publicados por la Estación Experimental.

B

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New Mexico College of Agriculture and Mechanic Arts

AGRICULTURAL EXPERIMENT STATION
STATE COLLEGE, N. M.

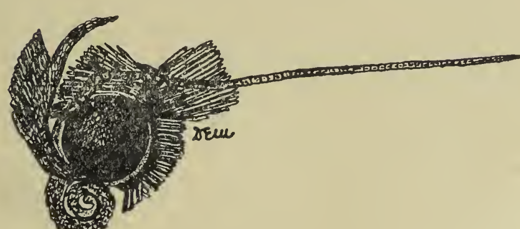

Fig. 1. Head from side of Anarsia lineatella Zell. (Original)

THE PEACH TWIG BORER
(Anarsia lineatella Zell.)

By D. E. MERRILL

Rio Grande Republic
Las Cruces, N. M.
1918

NEW MEXICO AGRICULTURAL EXPERIMENT STATION

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The Peach Twig Borer

INTRODUCTION

The peach twig borer or peach worm (Anarsia lineatella Zell.)* (Fig. 5), is a serious pest of the peach in years when it is numerous. In the summer of 1912 observations were begun on this pest at the Experiment Station and carried on as opportunity offered until 1915, when somewhat more definite work was done. The object of the investigation was mainly to test under local conditions control methods advised elsewhere and to improve such if necessary; also to learn of the life history and habits in general of this pest under conditions obtaining at the Experiment Station.

NATURE AND EXTENT OF INJURY

This pest is injurious in two ways. The overwintering larvae damage the tender shoots in spring when they are starting to grow rapidly. Shoots so attacked are either killed or stopped in their growth. Damage to the tree from this source is hard to estimate. However, it may run from only a few dead terminals to injury so serious that the tree will have hardly a single leafy terminal, the terminals sticking out in all directions as naked brush on the surface of the tree head.

Fig. 2. Peach twig showing injury in spring from overwintering larvae. (Original)

Damage is done in the second manner to the fruit directly. Larvae of the summer broods eat into the fruits, either on the surface or into the pit, and cause them to drop or decay. Such infested fruits, if they mature, are worthless for shipping, and must be disposed of at once and locally, if any value is real-

*Family Gelechiidae.

ized from them. In years of severe infestation damage may reach 50 per cent. or more of the fruits of later varieties. In other years damage runs less,—5 to 15 per cent. not being unusual. From this habit of attack in the fruit the pest is commonly called the "peach worm." The adults are not injurious.

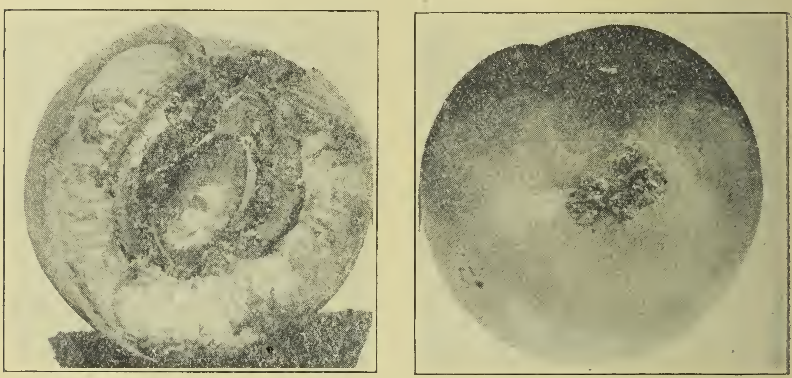

Fig. 3...Peaches showing deeper injury. Note broken pit and shrunken kernel. (Original)

Fig. 4. Peaches showing surface injury from larvae of peach twig borer. (Original)

GENERAL DESCRIPTION OF ADULT AND YOUNG

The adult moth, (Fig. 5), has a wing expanse of only 14 or 15 millimeters,—a little over 1-2 inch. It is dark gray in general color, the front wings being streaked with several short black lines and having a noticeable fringe on the outer margin. The hind wings are lighter in color and even more noticeably fringed. When the wings are closed closely over the back and moth is at rest on a piece of bark, it is very difficult to see, and rarely is seen by the casual observer.

The larva when full grown is about 10 to 12 millimeters long,—about 3-8 inch. It is brownish pink in color with the exception of the head and rear end. These regions are black.

Fig. 5. Adult moth (Anarsia lineatella Zell.) enlarged to show detail. (Original)

TIME OF APPEARANCE

The small overwintering larvae emerge from their winter quarters and begin work on the leaf buds about the first few days in April. The leaves are at this time about an inch long. From then till about May 1 these larvae may be found damaging the growing shoots. Then one is apt to lose sight of the pest until the peaches begin to ripen and later larvae are found in the fruits. For the rest of the peach fruiting season, then, larvae may be found, the number increasing as the season advances. The very late larvae hibernate.

HIBERNATING HABITS

Apparently only very young larvae hibernate. The us-

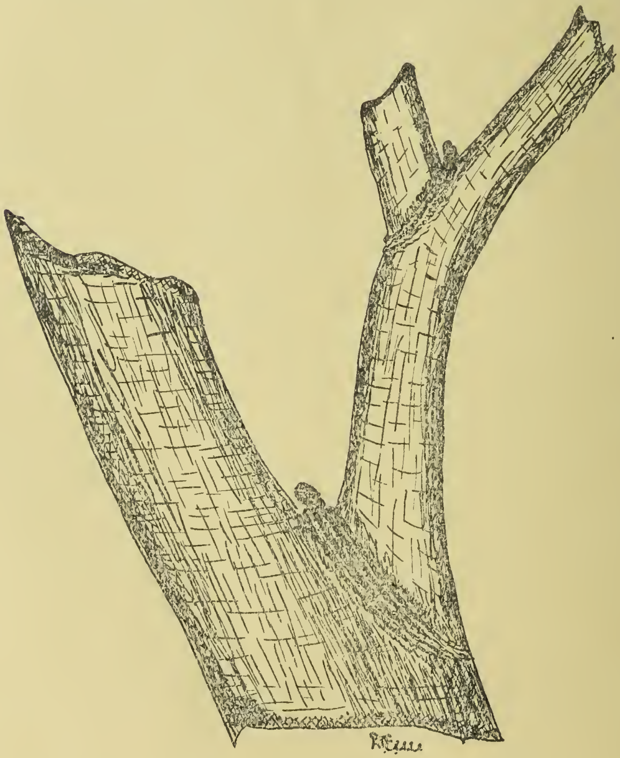

Fig. 6. Showing hibernaculae in place. X 6. (Original)

ual size is from 1 mm. to 1.5 mm. in length. Probably these represent parts of two broods,—the last brood that hatches when fruit is nearly gone,—or larvae of next to last brood that could find no fruit and so hibernated.

Hibernation was observed to begin as early as September 1. It takes place in small cells constructed in the softer tissues of the bark, usually in the crotches where the wood of this year joins that of last year. (Fig. 6). The hibernaculae may be found in older crotch bark. The position of the cells is indicated by small brown tubes projecting from the surface of the bark. These are made of silk and very fine chewings of bark. When the top is removed from a cell it is found to be lined with this silk, shallow, and somewhat larger than the larva, averaging 2.5 mm. to 3 mm. long by 1 mm. wide.

When a larva is taken from a cell in the fall it will, if opportunity is given, go back into the cell again and cover the broken part over with silk. They were noted to wander a foot or so up a twig and then return to the cell. The silken lining and cover render the hibernaculae water proof.

FOOD PLANTS AND FEEDING HABITS

The peach twig borer has been observed in the Mesilla Valley feeding on peaches and plums, the latter only in the fruit. Damage to plums does not seem to be so usual as to peaches, nor so severe. Dr. Quaintance in the Yearbook of the Department of Agriculture, 1905, records it as infesting also "the prune, nectarine, apricot, almond and pear."

When the small larva comes out of the winter cells it travels up the twig usually to a nearby expanding shoot. There it starts to eat the very tender tip, boring in for from a quarter to a half inch, stopping when the very tender growing tip is eaten. Next it travels up to the next shoot perhaps, and repeats. Shoots injured early may have the basal leaves left. As the shoots lengthen and the larvae get larger the burrows go clear to the hard wood and the whole leaf cluster usually dies. The terminals seem to be attached late and are usually left as bare sticks. (Fig. 2). One larva was observed to damage six shoots before maturing.

If a larva is driven from its feeding place it will usually

drop by a thread to escape. They are very active.

Figures 3 and 4 illustrate quite well the way in which the larvae attack the fruit of the peach. Early in the season, when the peaches are smaller, the attack is oftener at the stem end. Also, on peaches hanging alone the injury is inflicted at this place. On peaches in clusters damage is common where two fruits touch, or under a leaf where it touches the surface of a fruit.

The larva may feed in more or less superficial tunnels or pockets underneath the skin, or it may strike in and tunnel clear to the pit. The kernel was not observed to be eaten, but the damage causes the pit to burst usually. In one case an imprisoned moth was found in such a place where pupation and emergence had taken place inside the pit and the moth was unable to get out.

On young peaches the small feeding punctures may heal over. As many as eight punctures were observed in one peach. In the eighth hole the gum had caught the larva and it had died there. Fresh punctures are indicated by the open holes and chewings at the mouth of the hole.

Although most of the larvae enter the peach while it is on the tree, they continue to feed with no concern if the peach drops, and newly hatched larvae will enter dropped peaches if forced to. In confinement they feed readily on picked peaches, and if by chance larvae get into boxes of packed peaches they may do a great deal of damage by feeding perhaps on several fruits before maturing.

CULTURAL CONTROL MEASURES

Certain orchard practices are of considerable avail in lessening injury from this pest. Winter pruning removes a considerable number of the hibernating larvae but the brush should be removed from the orchard and burned. Since the insect may mature or even breed on fallen peaches, these should be gathered and utilized in some way so the insects would be destroyed before maturing.

LIGHT TRAPS

A lantern trap hung in the peach orchard in 1913 at the time of prevalence of moths hatching from the overwintering

larvae failed to yield any moths. Light traps with various colored electric lights were used in the codling moth experiments in an apple orchard adjacent to the peach orchard. Examination of these traps failed to show any moths of the peach twig borer.

BLACKLEAF 40

On April 17, 1915, 10 small peach trees were sprayed for aphis,—strength 1 pint+100 gals.+4 lbs. soap. The trees were also badly infested with the peach twig borer. Four days later the trees were examined to learn if the aphids were killed. Incidentally a dead larva of the peach twig borer was found in a twig. Search showed no living larvae present. Evidently the tobacco solution had killed them. More extensive work with this was contemplated but never done.

LIME SULPHUR

On April 14, 1914, lime sulphur solution was applied to 20 trees. The blossoms were all opened. Larvae nearly ready to pupate were found at time of spraying, so the application was too late. Home-made lime sulphur was used at a little less than dormant strength. The blossoms turned brown in a day's time, and a few of the opening leaves were injured. Evidently pollination had been effected, as there was a good set of fruit on the trees.

Living larvae and pupae were found on these trees a few days later, so the application was not effective.

In 1915, on March 20, lime sulphur was used on 70 trees. A commercial lime sulphur was used at 1:10 dilution. The buds were showing pink for the most part. A few were partly opened. The leaf buds were just starting green.

Later examination showed no damage to the buds, nor could living larvae be found in the twigs. Unsprayed trees yielded plenty of larvae.

SPRAYING

ARSENATE OF LEAD

On April 3, 1914, arsenate of lead, (Corona dry, 3 lbs. to 100 gallons water), was applied to 20 trees. The application

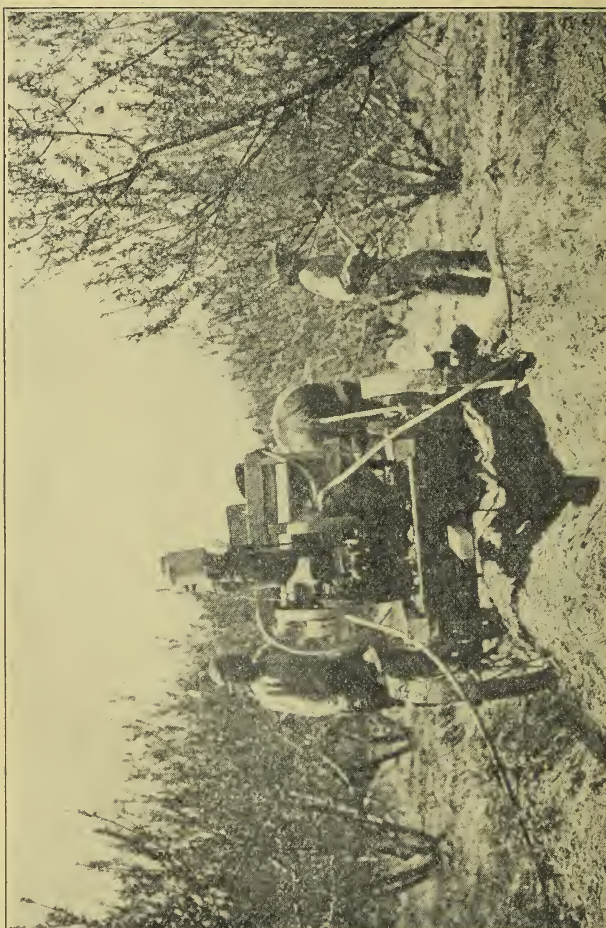

Fig. 7. Spraying for the peach twig borer. (Original)

was a little late, as about 1-2 of the blossoms were out and leaves were starting well.

On April 10 these trees were examined and only 2 larvae found at work. On unsprayed trees adjacent larvae were found commonly, being nearly half grown.

In the spring of 1915 this same spray was applied to two rows of peaches,—40 trees,—on March 20. Most of the buds were quite pink and some were nearly out. Leaf buds were just starting.

No injury was noted to the young leaves. Found no larvae on these trees, though on adjacent unsprayed trees they were plentiful.

To test the possibilities of lead arsenate as a summer spray against the larvae infesting the fruit, the following experiment was carried on:—

Two plats were selected,—Plat A, consisting of 6 small trees of various kinds of peaches, badly infested in the spring with larvae in the twigs; Plat B,—40 old trees of the Crothers variety. Corona dry lime sulphur was used at rate of 3 lbs. to 100 gallons of water. The results are given below.

PLAT A.

Sprayed May 7 and June 25. The sprays were timed as near as possible to maximum emergence of moths. On June 1 examination was made of the fruit on the trees. Only 3 larvae were found in a total of 423 fruits. At the time of picking no larvae were found in the fruits. Three trees ripened about July 20-26, two Aug. 20, one Sept. 23. The fruit ripening on the last two dates was burned considerably by the spray on the upper side by the stems. However, the fruits grew to normal size.

By July 26 the trees were dropping leaves badly. Practically all the basal leaves and many middle ones were dropped. Figure 8 shows typical condition of the trees. Some of the leaves were yellowish and some still green, and none showed brown spots such as arsenicals usually cause. The trees were normal in leaf, flower and fruit in following years.

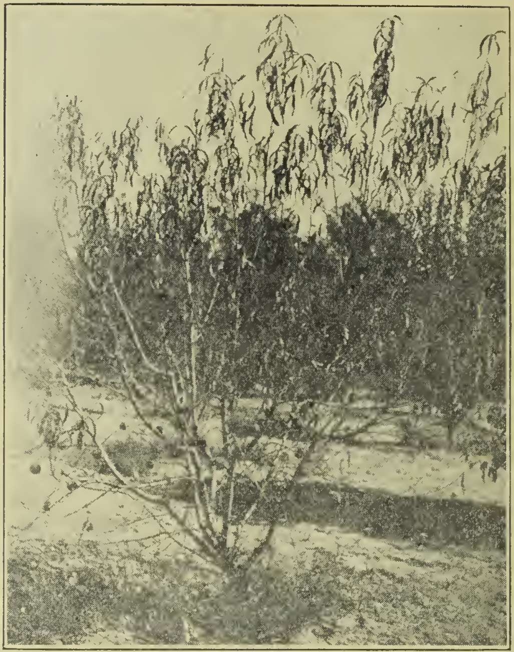

Fig. 8. Peach tree showing partial defoliation as result of summer spraying with arsenate of lead. (Original)

PLAT B.

These 40 trees were sprayed May 12 and June 25. By July 26 the condition of the foliage was practically the same as in A. The fruits were smaller than normal and showed indications of being burned. By August 30 it was estimated that 95 per cent. of the fruits were ruined by the spray. Near the stem usually was a sunken area more or less dry, and as a rule down the lower side was a dry-surfaced crack. The nature of the damage is shown in Figure 8. The fruits were much smaller than normal. The trees were normal in leaf, flower and fruit in succeeding years.

RECOMMENDATIONS FOR SPRAYING

Use arsenate of lead (powder), 3 lbs. to 100 *gallons, just as the buds show pink, or lime sulphur solution about* 1-10

weaker than the usual dormant spray when the buds are as above.

Control methods should be practiced by the entire community, otherwise infestation during the summer will take place in sprayed orchards from unsprayed ones.

Fig. 9. Burning of late peaches by arsenate of lead as a summer spray. (Original)

NOTES ON THE LIFE HISTORY

EGGS

The eggs are laid usually singly on the twigs near the peaches or directly upon the fruits, as was often the case especially on young fruits. They are elliptical in shape, .5 mm. x .25 mm. in size, yellowish when laid, becoming pink as the young worm develops. Head shows through as black dot.

Incubation lasts about 5 days on the average. No definite record was obtained of the number of eggs laid by a single female.

LARVA

The larva averages 1.25 mm. in length when hatched, is pinkish in general color, with black head and anal region. As it grows the general color becomes brown, but the black regions persist. The mature larva averages 10 to 12 mm.

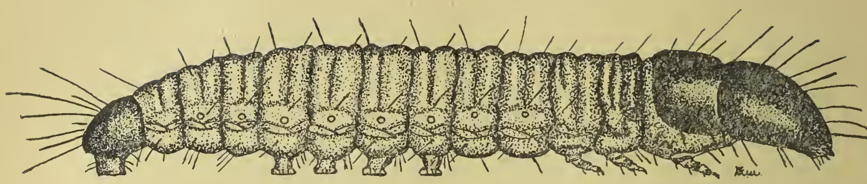

Fig. 10. Larva of Anarsia lineatella Zell., greatly enlarged. (Drawn from Colo. Rept.)

The time for maturing of the larvae varied in midsummer from 8 to 13 days.

Pupation takes place within about 24 hours after the larva matures.

PUPA

The pupa is shining brown in color, about 10 mm. in length. It is placed usually in some rough place in the bark and held in place by a very few silken threads. It is often to be found on the fruit itself, especially if the fruit be one of a cluster. Emergence occurs on the average of 8 to 12 days after pupation.

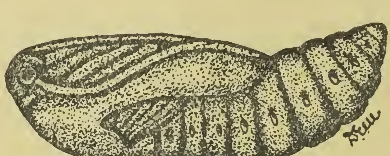

Fig. 11. Pupa of Anarsia lineatella Zell., enlarged. (Original)

THE BROODS

There are evidently three generations of this insect in a year. The overwintering larvae come out about the first week in April, and moths from these emerge from first to second week in May. Again moths are found in abundance from second to third week in June.

Eggs have been noted as late as the third week in August, and moths in numbers up to middle of August. The larvae from these last eggs and from those of the latter part of the preceding generation probably hibernate. The broods overlap exceedingly.

HISTORY AND DISTRIBUTION

Dr. Quaintance in the 1905 Yearbook of the U. S. Department of Agriculture, states that Anarsia lineatella "of European origin, and first noticed in this country in 1860, is now probably quite generally distributed over the United States. It is particularly destructive in the more western states, as California, Oregon and Washington."

Dr. Marlatt in U. S. D. A., B. E., Bul. 10, records it as occurring in Delaware, Illinois, Colorado, and Washington.

Quite evidently it may be found wherever the peach may go. In New Mexico it has been definitely recorded from the Mesilla and Pecos Valley regions. Its occurrence in very severe proportions in the Mesilla Valley is rather periodic, apparently. In 1912 the writer made its acquaintance first there, and it was very numerous. The next few years it was moderately injurious on an increasing scale until 1918, when again its damage was very severe, 50 per cent. of the crop in many orchards being injured more or less.

SUMMARY

1. The peach twig borer or peach worm, (*Anarsia lineatella Zell.*) is a serious pest of peaches in New Mexico.
2. Control may be effected by spraying just as the buds come pink, with arsenate of lead or lime sulphur.
3. Summer control methods proved of no practical avail.

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BULLETIN No. 117
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New Mexico College of Agriculture and Mechanic Arts

AGRICULTURAL EXPERIMENT STATION
STATE COLLEGE, N. M.

Poultry Feeding Experiment

By
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Rio Grande Republic
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NEW MEXICO AGRICULTURAL EXPERIMENT STATION

Introduction

This bulletin gives the results of a feeding experiment carried on for five months. The feeds range from all vegetable protein to heavy animal protein and are all "wheatless," in so far as whole grain is considered, and some have no wheat product, being truly "wheatless."

The most extraordinary feed conditions which have existed for the past two years have given occasion for many so called "War Time Poultry Rations." Many of these rations are practical for some parts of the United States and impossible for other parts; for instance, a ration containing these ingredients was recommended by one of the leading papers of the Southwest: wheat bran, wheat middlings, ground oats, corn meal, gluten meal, oil meal (linseed), short cut alfalfa, and meat scraps. Possibly a good ration but impossible in the Southwest. Gluten meal, wheat middlings, linseed oil meal and corn meal are not economically available and possibly if they were, the average farmer with the average farm flock is not in a mental position to use such a variety mixture. Such a combination of so many things does not seem necessary. Apparently the embargo on wheat as a feed for hens has been the generator of the idea that it was necessary to make exceptionally complex mixtures to replace the wheat. Not so, with the removal of wheat from the list of possible poultry feeds, other feeds have gone up in price by great leaps and it seems that for this reason the poultry ration should be simplified as much as possible but still contain those essential nutriments for egg producion.

Combined with unusable advice, there has been sold to the amateur back yard poultryman commercial hen feeds which were unpardonable in their composition and price. In February, 1918, one of the College classes in Poultry Husbandry made a mechanical analysis of several samples of commercial or prepared hen feeds. This is the composition of one sample: whole oats, 3.5 per cent; whole barley, 5.6 per cent; whole corn, 53.25 per cent; sunflower seed, 3.15 per cent; wheat, 9.75 per

cent; milo, 19.8 per cent; oyster shell, 2.2 per cent; grit, 2.3 per cent; charcoal, trace. If the separate ingredients of this feed had been purchased at regular retail prices and mixed by the consumer it would have cost about $5.00 per cwt. As it was this feed was selling for $6.00 per cwt. If back yard poultry keeping is to be encouraged such feeds as this particular one must be discouraged. It is to be remembered at this time that this is only one example of many of the prepared hen feeds. A good prepared hen feed is the most satisfactory one for the amateur back yard poultryman to use. Those dealers who have such feeds are, or at least should be, perfectly willing to give the exact contents. Rather than being injurious to their business it should be beneficial, in that a good feed will advertise itself in this way. It does not seem reasonable for a dealer to be satisfied with a profit of a quarter to a third of a cent per pound on straight grains and expect a cent and a half to two cents per pound for having mixed them.

OBJECT

This experiment was designed before the present feed situations existed and originally called for the determination of comparative values of wheat and kafir and milo and Indian corn as grains to be used in poultry feeding. At the same time the possibilities of cottonseed meal as a poultry feed were to be investigated. With the coming of the present difficult feed situation, alterations were made to meet the present requirements. The wheat on hand was used for seed and milo secured to replace it. The entire order was to design emergency rations and determine their value. This was done with the results presented herein.

DURATION OF EXPERIMENT

Originally the opening date was set for November 1, 1917, but not till January 15, 1918, was enough feed of all sorts secured to last long enough to begin the experiment. Some of the feeds were entirely used up just after June 15, 1918, so the experiment was terminated on that date. The results would be more complete for the entire year, but the period over which this bulletin reports gives probably the actual

egg producing qualities of the feeds in fairly true order. This report is divided into five periods. First period from January 15 to February 14; second period February 15 to March 14; third period from March 15 to April 14; fourth period from April 15 to May 14; fifth period from May 15 to June 15. Tabulations of each period are found in tables I to V.

Table 1. Detailed Statement for 31-day period, from Jan. 15 to Feb. 14, inclusive.

Pen Number	No. of hens in pen	Percent production	Average production per hen	Total production of pen	Average weight of eggs, in ounces	Ration number used	Total amount of feed consumed in pounds	Total cost of feed consumed, in dollars	Amount of feed consumed per hen, in pounds	Cost of feed per hen, in cents	Amount of feed consumed per dozen eggs, in pounds	Cost of feed per dozen of eggs, in cents	Percent of mash in total amount of feed consumed	Percent of oats in total amount of feed consumed	Percent of milo in total amount of feed consumed	Total weight of eggs produced by pen, in pounds	Pounds of feed used to produce a pound of eggs	Cost of feed, in cents, to produce a pound of eggs	Description of fowls in each pen
1	16	70.96	22.0	352	2 041	1	164.25	6.731	10.26	42.06	5.600	21.24	30.00	19.93	50.07	44.902	3.657	14.09	Pullets (Wyandotte)
D	31	20.39	6.32	196	1.961	1	167.00	6.657	5.387	21.47	11.89	40.76	15.13	23.05	61.82	24.022	6.951	27.71	Pullets (Leghorn)
E	25	30.45	9.44	236	2.075	1	171.00	6.850	6.840	27.40	8.697	34.84	17.70	22.51	59.79	30.606	5.587	22.38	Pullets (Leghorn)
H	28	21.65	6.71	188	1.784	1	176.75	6.925	6.312	24.73	11.28	44.22	16.41	25.88	57.70	20.962	8.431	33.03	Pullets (Leghorn)
C	33	17.59	5.45	180	2.275	2	194.25	7.720	5.886	23.39	12.95	51.46	21.89	21.87	56.24	25.593	7.589	30.16	Hens (Leghorn)
4	12	47.58	14.75	177	2.125	2	80.75	3.197	6.729	26.64	5.474	21.67	22.29	22.91	54.79	23.507	2.435	13.60	Hens (Leghorn)
7	12	43.54	13.50	162	2.143	2	82.50	3 287	6.875	27.39	6.111	24.34	22.43	21.21	56.36	21.697	3.802	15.14	Hens (Leghorn)
G	29	24.69	7.65	222	2.065	2	195.25	7.743	6.732	26.70	10.55	41.85	22.67	22.53	54.80	28.651	6.814	27.02	Pullets (Leghorn)
8	11	32.25	10.00	110	2.071	2	89.25	3.557	8.113	32.33	9.737	39.01	22.14	24.92	52.94	14.238	6.268	24.98	Pullets (R. I. Red)
B	33	29.81	9.24	305	2.115	3	192.50	7.585	5.833	22.98	7.575	29.85	23.13	21.81	55.06	40.317	4.774	18.81	Hens (Leghorn)
F	22	29.97	8.36	184	1.821	3	165.25	6.494	7.511	29.51	10.77	42.36	15.12	22.39	62.48	20.941	7.891	31.01	Pullets (Leghorn)
5	12	32.52	10.08	121	2.200	4	76.50	2.824	6.375	23.53	7.589	28.01	18.30	22.54	59.15	16.637	4.598	16.97	Hens (Leghorn)
6	12	32.52	10.08	121	2.166	4	79.75	2.907	6.645	24.22	7.911	28.83	22.26	22.26	55.48	16.380	4.868	17.74	Hens (Leghorn)
9	11	35.48	11.00	121	1.928	4	78.00	2.814	7.090	25.58	7.677	27.69	34.28	13.80	51.92	14.580	5.349	19.30	Pullets (R. I. Red)
10	9	39.78	12.33	111	2.100	4	77.25	2.315	8.583	25.72	8.351	25.02	19.75	25.24	55.01	14.568	5.302	15.89	Pullets (R. I. Red)
		33.94	10.46		2.058				7.011	26.91	8.882	33.41	21.56	22.19	56.24		5.621	21.91	Averages
Pen		1	1		C				1	1	C	C	9	H	F		H	F	
		70.96	22.0		2.275				10.26	42.06	12.95	51.46	34.28	25.88	62.48		8.431	31.01	Maximums
Pen		C	C		H				D	D	4	1	F	9	1		4	4	
		17.59	5.45		1.784				5.387	21.47	5.474	21.24	15.12	13.80	50.07		2.435	13.60	Minimums

Table II. Detailed Statement for 28-day period from Feb. 15 to March 14, inclusive.

Pen number	No. of hens in pen	Percent production	Average production per hen	Total production of pen	Average weight of eggs, in ounces	Ration number used	Total amount of feed consumed in pounds	Total cost of feed consumed, in dollars	Amount of feed consumed per hen in pounds	Cost of feed per hen, in cents	Amount of feed consumed per dozen eggs, in pounds	Cost of feed per dozen eggs, in cents	Percent of mash in total amount of feed consumed	Percent of oats in total amount of feed consumed	Percent of milo in total amount of feed consumed	Total weight of eggs produced by pen, in pounds	Pounds of feed used to produce a pound of eggs	Cost of feed, in cents, to produce a pound of eggs	Description of fowls in each pen
1	16	85.71	24.00	384	1.625	1	145.25	5.890	9.078	36.81	4.539	18.40	23.58	19.75	56.66	39.000	3.724	15.10	Pullets (Wyandotte)
D	31	60.02	16.80	521	1.937	1	162.25	6.581	5.233	21.22	3.737	15.16	27.87	22.34	49.76	63.073	2.572	10.43	Pullets (Leghorn)
E	25	67.14	18.80	470	2.022	1	162.00	6 576	6.480	26.30	4.136	16.79	28.55	22.37	49.07	59.396	2.727	11.07	Pullets (Leghorn)
H	28	69.89	19.57	548	1.920	1	166.75	6.634	5.955	23.69	3.651	14.52	23.25	26.08	50.67	65.760	2.535	10.08	Pullets (Leghorn)
C	33	61.58	17.24	569	2.157	2	234.25	9.375	7.098	28.40	4.940	19.77	33.42	20.59	45.99	76.708	3.053	12.22	Hens (Leghorn)
4	12	65.77	18.41	221	2.073	2	79.25	3.149	6.604	26.24	4.304	17.10	25.86	22.39	51.73	28.633	2.767	10.99	Hens (Leghorn)
7	12	64.28	18.00	216	2.160	2	86.25	3.489	7.187	29.07	4.791	19.38	31.88	18.27	49.35	29.160	2.957	11.96	Hens (Leghorn)
G	29	69.82	19.55	567	2.044	2	216.00	8.526	7.448	29.40	5.112	20.17	26.50	24.32	49.18	72.434	2.982	11.77	Pullets (Leghorn)
8	11	70.12	19.63	216	2.056	2	90.25	3 630	8.204	33.00	5.013	20.16	30.47	19.67	49.86	27.756	3.251	13.07	Pullets (R. I. Reds)
B	33	52.38	14.66	484	2.111	3	192.75	8.214	5.841	24.89	4.779	20.36	19.19	21.93	58.88	63.857	3.018	12.86	Hens (Leghorn)
F	22	56.49	15.81	348	2.011	3	142.25	5.504	6.465	25.01	4.905	18.97	14.93	26.53	58.52	43.739	3.252	14.78	Pullets (Leghorn)
5	12	48.51	13.59	163	2.187	4	71.25	2.631	5.937	21.92	5.246	19.37	20.00	21.05	58.94	22.280	3.153	11.80	Hens (Leghorn)
6	12	52.97	14.83	178	2.041	4	69.25	2.569	5.770	21.40	4.669	17.32	16.60	22.76	60.64	22.706	3.049	11.31	Hens (Leghorn)
9	11	64.28	18.00	198	1.897	4	85.00	3.040	7.727	27.63	5.151	18.42	30.01	20.29	49.70	23.475	3.620	12.94	Pullets (R. I Reds)
10	9	62.69	17.55	158	1.916	4	77.25	2.873	8.583	31.92	5.870	21.83	17.15	21.69	61.16	18.920	4.082	15.18	Pullets (R. I Reds)
		63.44	17.76		2.010				6.907	27.12	4.722	18.51	24.61	22.00	53.37		3.113	12.37	Averages
Pen		1	1		5				1	1	10	10	C	F	10		10	10	
		85.71	24.00		2.187				9.078	36.81	5.870	21.83	33.42	26.53	61.16		4.082	15.18	Maximums
Pen		B	B		1				D	D	H	H	F	7	E		H	H	
		52.38	14.66		1.625				5.233	21.22	3.651	14.52	14.93	18.27	49.07		2.535	10.08	Minimums

Table III. Detailed Statement for 31-day period from March 15 to April 14, Inclusive.

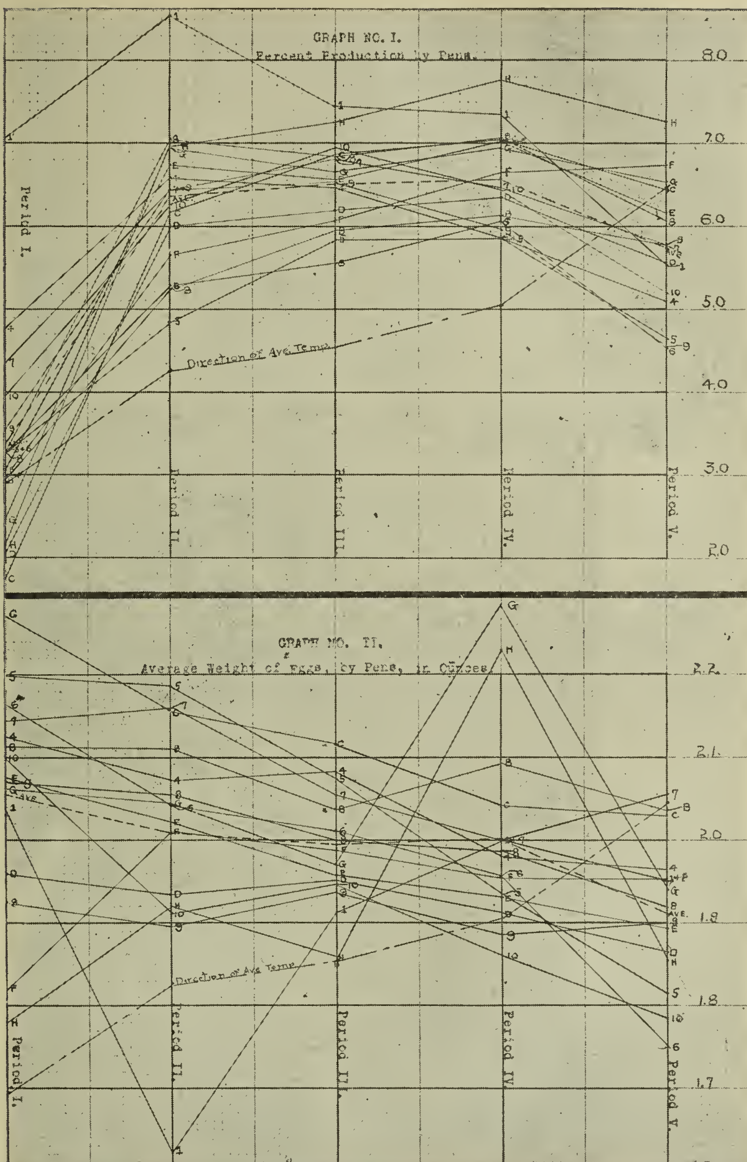
Pen number	No. of hens in pen	Percent production	Average production per hen	Total production of pen	Average weight of eggs, in ounces	Ration number used	Total amount of feed consumed in pounds	Total cost of feed consumed, in dollars	Amount of feed consumed per hen in pounds	Cost of feed per hen, in cents	Amount of feed consumed per dozen eggs, in pounds	Cost of feed per dozen eggs, in cents	Percent of mash in total amount of feed consumed	Percent of oats in total amount of feed consumed	Percent of milo in total amount of feed consumed	Total weight of eggs produced by pen, in pounds	Pounds of feed used to produce a pound of eggs	Cost of feed, in cents, to produce a pound of eggs	Description of fowls in each pen
1	16	74.59	23.12	370	1.916	1	142.50	5.746	8.906	35.91	4.622	18.63	24.91	22.80	52.28	44.307	3.216	12.96	Pullets (Wyandotte)
D	31	62.01	19.22	596	1.953	1	176.75	7.236	5.701	23.34	3.559	14.57	28.00	19.80	52.19	72.749	2.429	9.946	Pullets (Leghorn)
E	25	65.54	20.32	508	1.959	1	165.75	6.793	6.630	27.17	3.915	16.04	26.54	19.00	54.44	62.198	2.664	10.92	Pullets (Leghorn)
H	28	72.46	22.46	629	1.859	1	196.75	7.968	7.026	28.45	3.754	15.20	24.66	21.60	53.74	73.802	2.665	10.90	Pullets (Leghorn)
C	33	68.81	21.33	704	2.117	2	236.25	9.489	7.159	28.75	4.027	16.17	33.86	20.54	45.60	93.148	2.536	10.18	Hens (Leghorn)
4	12	64.78	20.08	241	2.083	2	77.75	3.092	6.479	25.76	3.872	15.39	23.79	21.86	54.34	31.375	2.478	9.854	Hens (Leghorn)
7	12	68.01	21.08	253	2.054	2	86.75	3.439	7.229	28.65	4.115	16.31	30.27	23.63	46.10	32.478	2.671	10.58	Hens (Leghorn)
G	29	66.40	20.58	597	1.971	2	217.50	8.544	7.500	29.46	4.371	17.17	25.51	25.51	48.97	73.543	2.957	11.61	Pullets (Leghorn)
8	11	68.62	21.27	234	2.000	2	93.50	3.610	8.500	32.81	5.102	18.51	29.43	22.45	48.12	29.250	3.196	12.34	Pullets (R. I. Red)
B	33	59.43	18.42	608	2.049	3	214.00	8.493	6.484	25.73	4.224	16.76	24.31	19.85	55.84	77.862	2.748	10.90	Hens (Leghorn)
F	22	60.99	18.90	416	1.988	3	167.25	5.641	7.602	30.18	4.825	19.16	25.11	19.73	55.15	51.688	3.235	12.48	Pullets (Leghorn)
5	12	58.33	18.08	217	2.075	4	78.50	2.846	6.541	23.71	4.341	15.74	24.20	21.97	53.82	28.142	2.789	10.11	Hens (Leghorn)
6	12	55.37	17.16	206	2.012	4	77.50	2.818	6.458	23.48	4.516	16.42	20.32	24.51	55.16	25.904	2.991	10.87	Hens (Leghorn)
9	11	65.39	20.27	223	1.937	4	84.75	3.030	7.704	27.54	4.561	16.30	28.31	21.84	49.85	26.996	3.139	11.23	Pullets (R. I. Red)
10	9	69.89	21.64	195	1.947	4	71.25	2.641	7.916	29.04	4.384	16.08	16.15	25.96	57.89	23.729	3.002	11.01	Pullets (R. I. Red)
		65.37	20.26		1.994				7.135	27.99	4.279	16.56	24.35	22.09	52.23		2.847	11.05	Averages
Pen		1	1		4				1	1	8	F	C	10	10		F	F	
		74.59	23.12		2.083				8.906	35.91	5.102	19.16	33.86	25.96	57.89		3.235	12.48	Maximums
Pen		6	6		H				6	D	D	D	10	E	C		D	4	
		55.37	18.08		1.859				6.458	23.34	3.559	14.57	16.15	19.00	45.60		2.429	9.854	Minimums

Table IV. Detailed Statement for 30-day period from April 15 to May 14, inclusive.

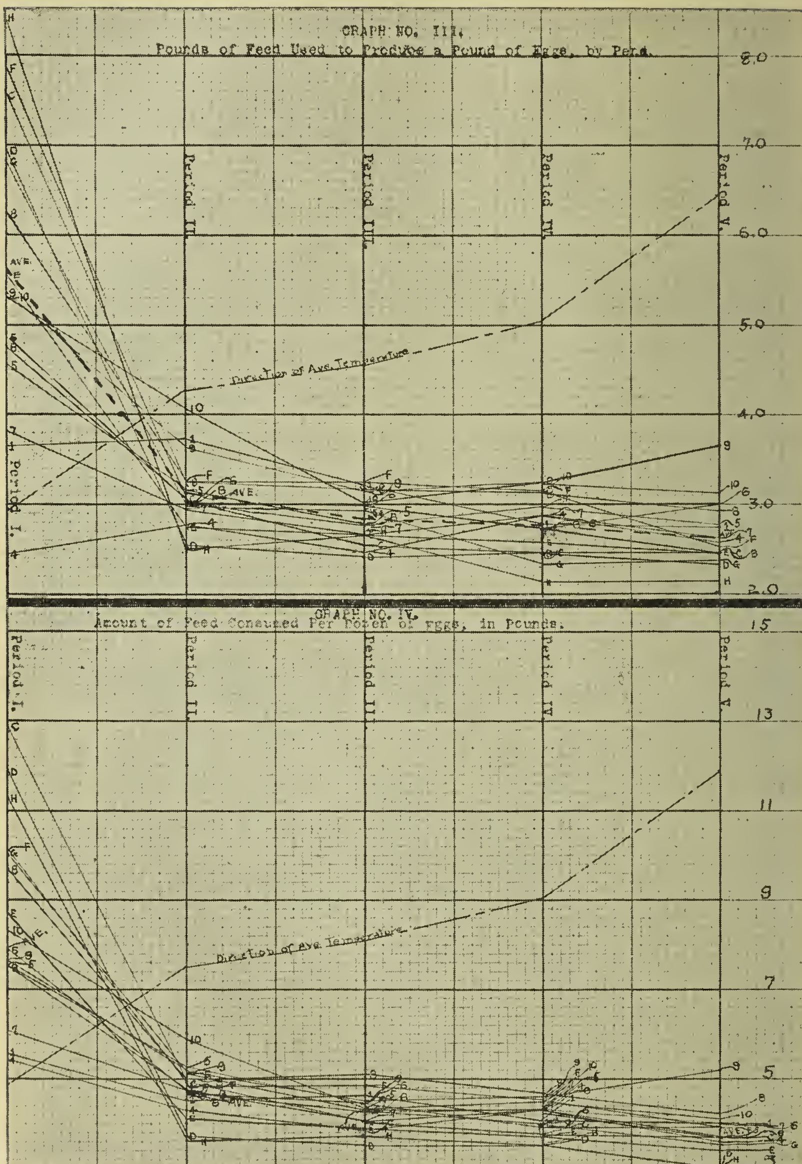
Pen number	No. of hens in pen	Percent production	Average production per hen	Total production of pen	Average weight of eggs, in ounces	Ration number used	Total amount of feed consumed in pounds	Total cost of feed consumed, in dollars	Amount of feed consumed per hen in pounds	Cost of feed per hen, in cents	Amount of feed consumed per dozen eggs, in pounds	Cost of feed per dozen eggs, in cents	Percent of mash in total amount of feed consumed	Percent of oats in total amount of feed consumed	Percent of milo in total amount of feed consumed	Total weight of eggs produced by pen, in pounds	Pounds of feed used to produce a pound of eggs	Cost of feed, in cents, to produce a pound of eggs	Description of fowls in each pen
1	16	73.54	22.06	353	2.000	1	123.00	4.981	7.687	31.13	4.182	16.93	21.95	20.72	57.33	44.125	2.787	11.28	Pullets (Wyandotte)
D	31	63.87	19.16	594	1.913	1	175.50	7.252	5.661	23.39	3.545	14.65	29.05	17.52	53.41	71.020	2.471	10.21	Pullets (Leghorn)
E	25	70.26	21.08	527	1.932	1	163.00	6.710	6.520	26.84	3.712	15.28	26.09	17.63	56.28	63.635	2.561	10.54	Pullets (Leghorn)
H	28	76.30	22.89	641	2.230	1	190.25	7.921	6.794	28.28	3.562	14.83	31.80	16.02	52.17	89.339	2.129	8.866	Pullets (Leghorn)
C	33	70.40	21.12	697	2.042	2	219.50	8.326	6.651	26.74	3.779	15.19	26.55	19.24	54.21	88.954	2.467	9.921	Hens (Leghorn)
4	12	58.33	17.50	210	1.980	2	75.00	2.991	6.250	24.92	4.285	17.09	20.33	20.66	59.00	25.987	2.886	11.50	Hens (Leghorn)
7	12	64.72	19.41	233	2.000	2	84.25	3.389	7.020	28.24	4.340	17.46	26.11	19.00	54.88	29.125	2.892	11.63	Hens (Leghorn)
G	29	69.42	20.82	604	2.285	2	201.75	8.070	6.956	27.82	4.008	16.03	22.05	20.07	57.86	86.258	2.338	9.355	Pullets (Leghorn)
8	11	70.60	21.18	233	1.989	2	90.25	3.617	8.204	32.88	4.649	18.63	29.36	20.51	50.13	28.964	3.115	12.48	Pullets (R I. Red)
B	33	61.01	18.30	604	2.095	3	213.75	8.445	6.477	25.59	4.246	16.77	21.05	21.05	57.90	79.086	2.702	10.67	Hens (Leghorn)
F	22	66.96	20.09	442	1.954	3	169.00	6.721	7.681	30.55	4.588	18.03	20.85	19.23	59.91	53.730	3.145	12.50	Pullets (Leghorn)
5	12	58.33	17.50	210	1.934	4	75.50	2.738	6.291	22.81	4.314	15.64	26.15	20.19	53.64	25.385	2.974	10.78	Hens (Leghorn)
6	12	60.55	18.16	218	1.956	4	72.25	2.684	6.020	22.36	3.978	14.77	17.30	21.79	60.89	26.650	2.711	10.07	Hens (Leghorn)
9	11	59.09	17.72	195	1.887	4	75.00	2.750	6.818	25.00	4.615	16.92	19.34	23.33	57.33	22.997	3.261	11.95	Pullets (R. I. Red)
10	9	64.81	19.44	175	1.862	4	66.00	2.459	7.333	27.32	4.526	16.86	14.01	23.87	62.12	20.365	3.240	12.07	Pullets (R I. Red)
		65.87	19.76		2.003				6.824	26.92	4.155	16.27	23.46	20.05	56.47		2.778	10.92	Averages
Pen		H	H		G				8	8	8	8	H	10	10		9	F	
		76.30	22.89		2.285				8.204	32.88	4.649	18.63	31.80	23.87	62.12		3.261	12.50	Maximums
Pen		4&5	4&5		10				D	6	D	D	10	H	8		H	H	
		58.33	17.50		1.862				5.661	22.36	3.545	14.65	14.01	16.03	50.13		2.129	8.866	Minimums

Table V. Detailed Statement for 32-day period from May 15 to June 15, inclusive.

Pen number	No. of hens in pen	Percent production	Average production per hen	Total production of pen	Average weight of eggs, in ounces	Ration number used	Total amount of feed consumed in pounds	Total cost of feed consumed, in dollars	Amount of feed consumed per hen in pounds	Cost of feed per hen, in cents	Amount of feed consumed per dozen eggs, in pounds	Cost of feed per dozen eggs, in cents	Percent of mash in total amount of feed consumed	Percent of oats in total amount of feed consumed	Percent of milo in total amount of feed consumed	Total weight of eggs produced by pen, in pounds	Pounds of feed used to produce a pound of eggs	Cost of feed, in cents, to produce a pound of eggs	Description of fowls in each pen
1	16	55.07	17.62	282	1.953	1	95.25	3.431	5.953	21.44	4.053	14.60	20.73	20.47	58.79	34.421	2.767	9.915	Pullets (Wyandotte)
D	31	55.44	17.74	550	1.865	1	149.25	6.187	4.814	19.95	3.056	12.67	31.00	16.24	52.76	64.190	2.325	9.638	Pullets (Leghorn)
E	25	61.87	19.80	495	1.894	1	140.50	5.790	5.620	23.16	3.406	14.03	27.58	17.79	54.62	57.203	2.456	10.12	Pullets (Leghorn)
H	28	72.99	23.35	654	1.854	1	163.50	6.924	5.839	24.72	3.000	12.70	33.95	11.77	54.28	75.782	2.157	9.136	Pullets (Leghorn)
C	33	64.67	20.69	683	2.030	2	213.75	8.679	6.477	26.30	3.755	15.25	23.51	16.14	60.35	86.655	2.466	10.01	Hens (Leghorn)
4	12	51.04	16.33	196	1.965	2	62.50	2.495	5.208	20.79	3.827	15.27	20.40	20.40	59.20	24.071	2.596	9.610	Hens (Leghorn)
7	12	57.81	18.50	222	2.058	2	74.50	2.972	6.208	24.76	4.027	16.06	24.50	21.14	54.36	28.554	2.610	10.40	Hens (Leghorn)
G	29	65.30	20.89	606	1.942	2	176.00	7.076	6.068	24.40	3.485	14.01	23.86	18.89	57.24	73.553	2.392	9.620	Pullets (Leghorn)
8	11	60.79	19.45	214	1.921	2	75.25	3.000	6.840	27.27	4.220	16.82	19.61	20.59	59.80	25.693	2.928	11.67	Pullets (R. I. Red)
B	33	57.85	18.51	611	2.035	3	191.25	7.544	5.795	22.86	3.756	14.81	20.67	21.43	57.90	77.711	2.461	9.707	Hens (Leghorn)
F	22	67.32	21.54	474	1.953	3	145.25	5.768	6.602	26.21	3.677	14.60	21.34	19.62	59.03	57.857	2.510	9.969	Pullets (Leghorn)
5	12	46.35	14.83	178	1.815	4	56.25	2.063	4.687	17.19	3.792	13.91	22.66	20.44	56.88	20.191	2.785	10.21	Hens (Leghorn)
6	12	45.05	14.41	173	1.750	4	58.00	2.153	4.833	17.94	4.024	14.94	16.81	22.41	60.77	18.931	3.065	11.37	Hens (Leghorn)
9	11	45.17	14.45	159	1.903	4	69.25	2.568	6.295	23.34	5.226	19.38	15.90	23.46	60.64	18.911	3.661	13.57	Pullets (R I. Red)
10	9	52.08	16.66	150	1.785	4	52.25	1.994	5.805	22.15	4.108	15.95	20.58	11.96	67.46	16.734	3.122	11.91	Pullets (R. I. Red)
		57.25	18.31		1.914				5.802	22.83	3.827	15.00	22.87	18.85	58.27		2.686	10.45	Averages
Pen		H	H		7				8	8	9	9	H	9	10		9	9	
		72.99	23.35		2.058				6.840	27.27	5.226	19.38	33.95	23.46	67.46		3.661	13.57	Maximums
Pen		6	6		6				5	5	H	D	9	H	D		H	H	
		45.05	14.41		1.750				4.687	17.19	3.000	12.67	15.90	11.77	52.76		2.157	9.136	Minimums



Graphical Representation of Tables I. to V. Inclusive.



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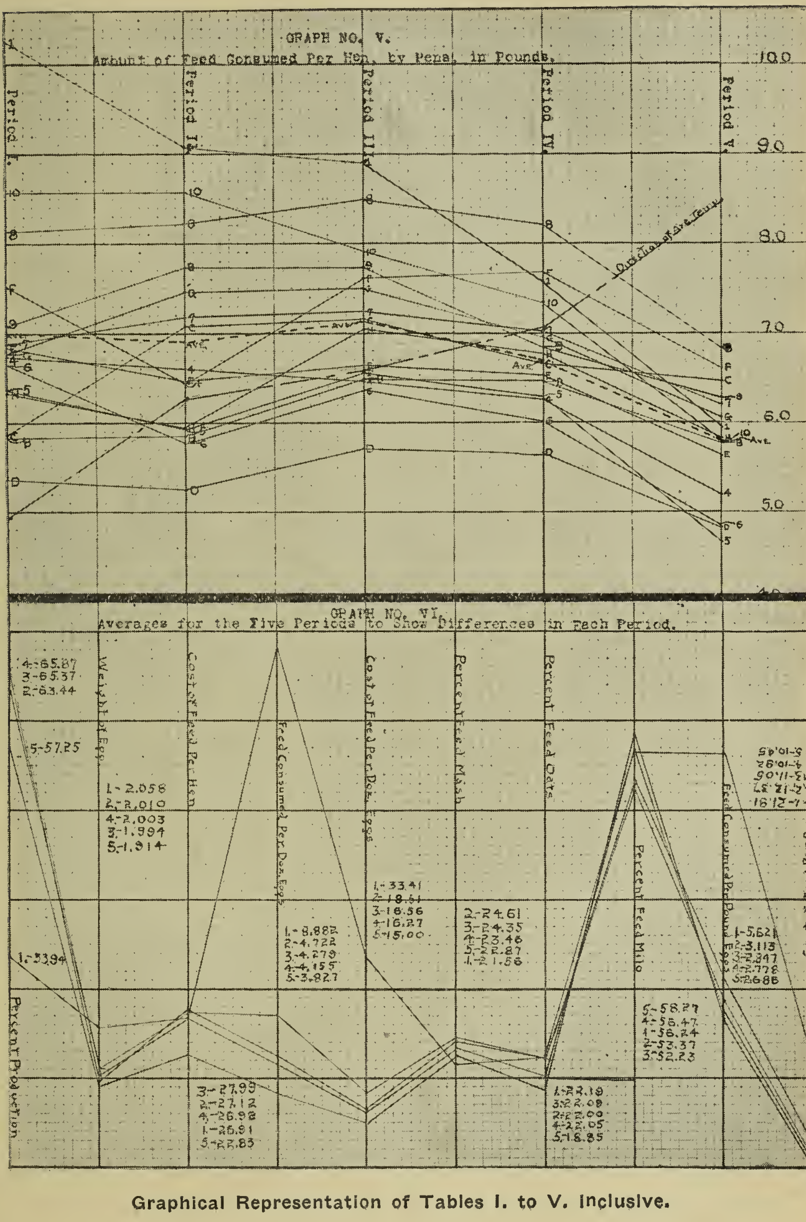


Graphical Representation of Tables I. to V. Inclusive.

THE FOWLS USED

One pen of White Wyandotte pullets, three pens of Single Comb Rhode Island Red pullets, five pens of White Leghorn pullets and six pens of White Leghorn hens were used in this experiment. The oldest Leghorn pullets were hatched on April first and the youngest on May fifteenth. The Wyandottes were all hatched on March sixteenth. The Rhode Island Reds were late hatched and did not begin laying till just before the experiment started; they were hatched June fourteenth, which is entirely too late for chicks to be hatched in this country. The Leghorn year old hens were all hatched on April 20, 1916. In making the pens of Leghorn pullets a proportionate number of the same age were put in each pen. During the breeding season there were three cockerels in each of the large pens and one in each of the small pens. Reserve fowls were maintained for each pen so that sick fowls were replaced. However, only three fowls were required to be removed from the pens.

HOUSING AND YARDING CONDITIONS

All the numbered pens were in colony houses seven by seven feet, which were in yards fifty by fifty feet. The lettered pens were in a long house sixteen by ninety-six feet, which is divided into pens twelve by sixteen feet. The yards connected with this house are twelve by one hundred feet. Each pen has running water and also has alfalfa growing in the yards.

The following table gives the temperature conditions during the experiment:

Period	Average Temp. °F	Average Maximum °F	Average Minimum °F	Average Range °F	Highest Temp. °F	Lowest Temp. °F	Greatest Range °F	Smallest Range °F
I.	39.80	55.35	24.25	31.09	75	1	50	5
II.	52.94	68.96	36.92	32.02	81	20	46	11
III.	55.44	71.93	38.96	32.96	82	18	50	12
IV.	60.31	76.70	43.93	32.76	89	33	45	13
V.	74.51	89.12	59.90	35.96	96	40	47	23

The following are the rations used during the experiment:

Ration No.	Bran	Ground Milo	Meat Scraps	Ground Oats	Alfalfa Meal	Cottonseed Meal	Nutritive Ratio	Cost per Cwt.
1.	10.00	5.00	10.00	none	none	none	1:1.886	$4.71
2.	10.00	none	10.00	5.00	none	none	1:1.819	$4.44
3.	none	none	10.00	5.00	10.00	none	1:1.543	$4.28
4.	10.00	none	none	5.00	none	15.00	1:2.277	$2.99

The prices of feed stuffs per cwt. during the experiment were as follows:

Milo, $4.25. Whole Oats, $2.80. Cottonseed Meal, $3.25. Ground Oats, $2.90. Ground Milo, $4.35. Beef Scraps, $7.00, Alfalfa Meal, $2.25. Ground grain is figured at ten cents per cwt. higher than the whole grain.

The feeding stuffs used in compounding these rations are those which are available to most farmers. Meat scraps are not readily available in all parts of the State, but a little encouragement in any locality for a merchant to handle this feed would be justifiable. Even if high in price it is a cheap feed when the results obtained from feeding it are considered. Wheat bran was not to be had in some localities during part of last winter, and corn bran was scarce. It is regretted that corn bran was not included in some of the rations used in this experiment, but there was no corn bran to be had for some time after the experiment was actually started. The prices used in calculating costs are actual retail prices just prior to the experiment and at a time when a supply could be obtained. The prices differed some during the five months, but a fixed price in computing costs was considered more satisfactory than to follow the market changes, which would have been quite small.

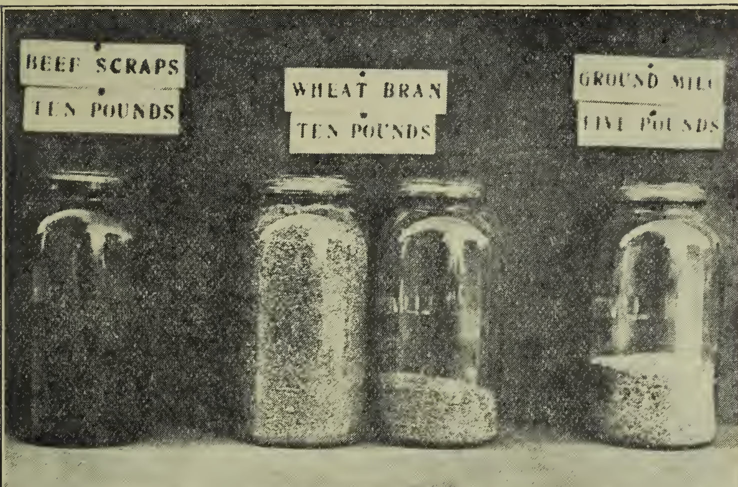
METHOD OF FEEDING

All mashes were fed dry in open hoppers and were kept before the fowls at all times; this to conserve on labor and give

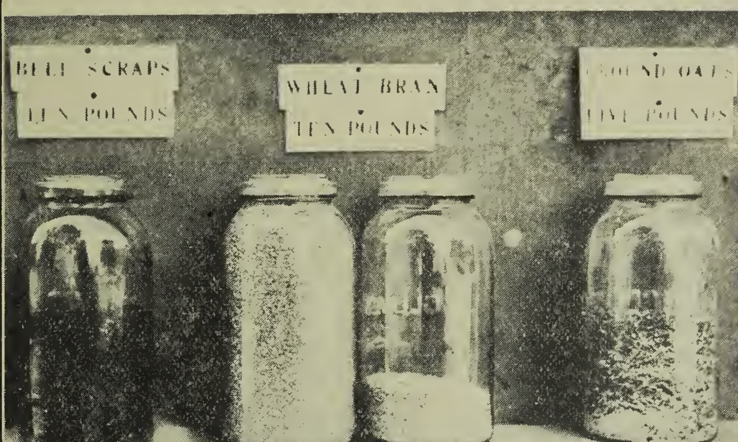
opportunity to consume all the mash possible. A deep straw litter was kept on the floors, in which the whole grains were fed. At nine thirty in the morning the whole oats were scattered in the scratch litter. This feed was estimated so that it would be about one-third of the total amount of whole grain. At eleven thirty notice was taken of the amount of oats still remaining in the litter; and according to this the amount the pen would consume in that time was regulated. About three hours before roosting time the milo was fed, and the amount cleaned up by the pen before roosting time was determined by frequent trips through the house after roosting time to examine the crop capacity of the fowls and also the amount of grain still on the floor. Oystershell was kept in open boxes, as was also granite grit. There was also a load of medium sand and gravel available to each pen. When the alfalfa in the yards was not in growing condition all the fresh rape and beets the fowls would eat were given them each day.

COTTONSEED MEAL

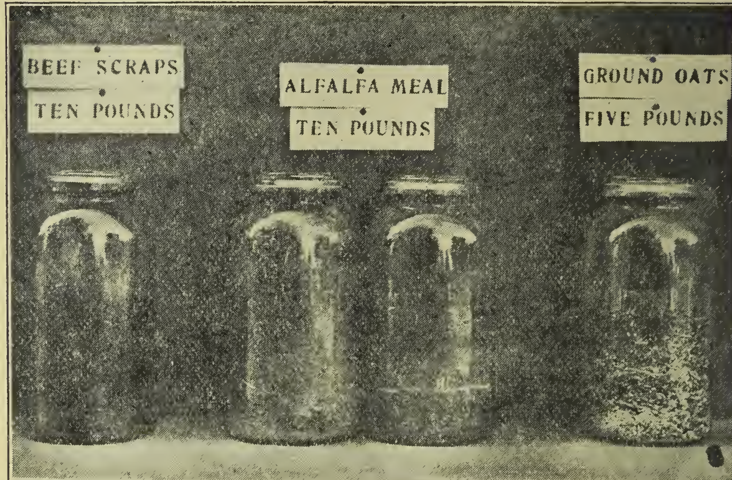
In view of the fact that cottonseed meal is a common concentrate in this part of the Southwest and is openly advocated and just as openly discouraged as an egg producing feed, some special attention was given to the results from the pens receiving it as their protein concentrate. A careful examination of all the eggs produced by those pens showed that in the pullet pens (Nos. 9 and 10) there were found no "cottonseed meal spots," and in the hen pens there was found 8.17 per cent. of the eggs from pen 5 and 7.41 per cent. of the eggs from pen 6 containing these spots. A cottonseed meal spot in an egg is a brown spot with a greenish tinge ranging in size from a pin point to a quarter of an inch in diameter, and often there will be several in the egg. This spot floats on the surface of the yolk and is readily seen when candled. The matter of fertility and hatchability was considered. Of all the eggs set from these four pens 46.25 per cent. hatched, 33.75 per cent. were dead in the shell at the end of the twenty-first day, 8.75 per cent. were infertile on or before the fourteenth day; and there were 11.25 per cent. dead embryos on or before the fourteenth



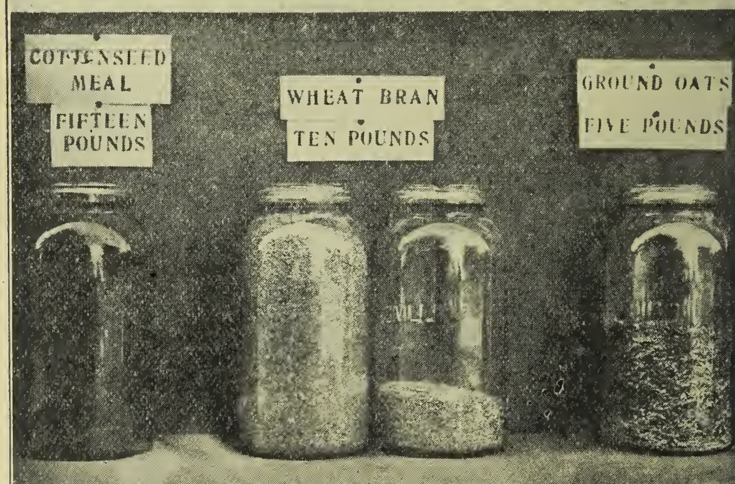
Ration Number One Weighed and Measured in Two-Quart Jars, showing the relation of weight to measure.



Ration Number Two Weighed and Measured in Two-Quart Jars, showing the relation of weight to measure.



Ration Number Three Weighed and Measured in Two-Quart Jars, showing the relation of weight to measure.



Ration Number Four Weighed and Measured in Two-Quart Jars, showing the relation of weight to measure.

day. The dead in the shell were, in all probability, as much or more due to incubation than to any effect caused by cottonseed meal. The feeding of cottonseed meal apparently does not have an injurious effect upon the fertility or hatchability of the egg, nor did it show spots on the eggs produced in the pullet pens. It does, however, produce enough spots on the eggs to make the feeding of it not advisable unless all eggs are candled before being sent to market. The spot does not make the egg unfit for use, but has the effect of making it lacking in that appetizing freshness of appearance so necessary to sell eggs on the market at a fancy or even high price.

The Relation of the Amount of Food Consumed to the Number of Eggs Produced.

Period I.				Period II.				Period III.				Period IV.				Period V.			
W	X	Y	Z	W	X	Y	Z	W	X	Y	Z	W	X	Y	Z	W	X	Y	Z
1	1	1	14	1	1	1	2	1	1	1	2	H	1	8	15	H	1	8	15
4	2	9	15	8	2	3	5	H	1	9	11	1	1	3	8	F	3	2	9
7	2	6	13	H	1	11	15	10	4	3	5	8	2	2	4	G	2	6	13
10	4	2	9	G	2	5	10	C	2	8	13	C	2	9	13	C	2	3	10
9	4	5	8	E	1	9	13	8	2	2	3	E	1	10	11	E	1	11	12
Ave				4	2	8	12	7	2	7	10	G	2	6	14	8	2	1	4
5	4	11	12	7	2	6	11	G	2	6	7	F	3	2	3	B	3	10	11
6	4	10	10	9	4	4	3	E	1	10	12	Ave				7	2	5	7
8	2	3	6	Ave				9	4	4	4	7	2	5	6	Ave			
E	1	7	7	10	4	2	1	Ave				10	4	4	2	D	1	14	14
F	3	4	2	C	2	7	7	4	2	13	14	D	1	15	12	1	1	7	6
B	3	14	11	D	1	15	14	D	1	15	15	B	3	11	1	10	4	9	2
G	2	8	5	F	3	10	4	F	3	5	1	6	4	14	9	4	2	12	8
H	1	12	1	6	4	14	8	B	3	12	9	9	4	7	1	5	4	15	5
D	1	15	4	B	3	13	9	5	4	11	8	4	2	13	7	9	4	4	1
C	2	13	3	5	4	12	6	6	4	14	5	5	4	12	5	6	4	13	3

FOOD CONSUMPTION AND EGG PRODUCTION

In the preceding table under columns marked "W" is given the order of production by pens with the average noted between the pens where it comes, thus giving the pens above and those below the average in their proper order. Columns marked X indicate the number of the rations used in each pen. Columns marked Y give the order or rank of the pens in column W for the amount of feed consumed per hen. Columns marked Z give the rank of pens for the amount of feed required to produce a pound of eggs; for example, Pen 1 was the high-

est producing pen during the period I. (Column W), it was given ration No. 1 (Column X), consumed more feed per hen than any other pen (Column Y) and produced more pounds of eggs per pound of feed consumed than any other pen excepting pen 4 (Column Z).

Attention is called to the fact that a general tendency exists in this table toward the highest producers being the smallest consumers per pound of eggs produced. In the matter of production no one pen remained above the average for the entire five periods. Pens 1, H, E receiving ration No. 1 and Pens 7, 8, G, receiving ration No. 2, were above the average for four of the five periods. Pen 9 receiving ration No. 4 and pen C receiving ration No. 2 were above the average three of the five periods. Pen 10 receiving ration No. 4, pen 4 receiving ration No. 2 and pen F receiving ration No. 3, were above the average two of the five periods. Pen B receiving ration No. 3 was above the average for one of the five periods. Pens 5 and 6 receiving ration No. 4 and pen D receiving ration No. 1 were never above the average in egg production. In the matter of food consumption pens 9 and 10 receiving ration No. 4, pen 1 receiving ration No. 1, pen 8 receiving ration No. 2 and pen F receiving ration No. 3 were above the average for four of the five periods. Pen C receiving ration No. 2 was above the average in three of the five periods. Pens D and E receiving ration No. 1, pens 5 and 6 receiving ration No. 4, pen 4 receiving ration No. 2 and pen B receiving ration No. 3 were never above the average.

In making a direct comparison between egg production and food consumption it is found that six pens were during three or more periods above the average in both egg production and food consumption, and five pens were during two periods or less not above the average in egg production nor food consumption. This leaves four pens which were unequal in production and consumption. However, in these four remaining pens the variation is not great, excepting in one of them. Pen 10 was above the average in food consumption during all five periods and was above the average in egg production 2 of the 5 periods. Pens H and F alternate in that H was above the average 4 of the five periods in egg production

and F in food consumption. F was above the average 2 of the 5 periods in egg production and H in food consumption. This leaves pen E as the only extreme, it being above the average in egg production four of the five periods and never above the average in food consumption. This is illustrated in the following table.

Showing the Heavy Consumer to be a Heavy Producer.

Pens always over the average		Pens 4 times over the average		Pens 3 times over the average		Pens 2 times over the average		Pens 1 time over the average		Pens never over the average	
in egg production	in food consumption	in egg production	in food consumption	in egg production	in food consumption	in egg production	in food consumption	in egg production	in food consumption	in egg production	in food consumption
	1 8 9	1 7 8 G	G 7	9 C	C	4		B		D 5 6	4 5 6 B D
	10	H E	F			10 F	H				E

CONCLUSIONS RELATIVE TO COTTONSEED MEAL

1. Cottonseed meal when fed even in large amounts does not have a deteriorating effect upon the health of the fowls, the fertility of the eggs or the hatchability of the eggs.

2. In this experiment only the eggs produced by hens in their second laying year were affected by the "Cottonseed Meal Spot." Eggs produced by pullets did not contain these spots.

3. Hens make good use of the protein contained in cottonseed meal for egg production.

4. It is not recommended that cottonseed meal be used extensively by farmers and poultrymen in the laying ration. It is made clear, however, that the cottonseed meal picked up by the hens around cattle feeding yards will not injure the hens and will be of some benefit in egg production.

5. Farmers and ranchmen may use a limited amount of

cottonseed meal in the laying mash where eggs are produced for home consumption only. The "Cottonseed Meal Spot" is not desirable in eggs placed on the market; although it does not injure the flavor of the egg, its appearance is not understood by the consuming public.

SUMMARY

1. Egg production is largely dependent upon the consumption of enough egg producing nutriments by the hen.

2. Those pens consuming the greatest amount of feed were almost without exception the pens producing the greatest amount of eggs.

3. The results obtained indicate that the different rations used had very similar feeding values.

4. The matter of a suitable egg producing ration is not a matter of following a rule but of utilizing those feeds which are available most economically to the feeder; proper nutriments and then sufficient quantity consumed by the hens, always being the final object in feed selection.

5. Food consumption and egg production are closely related and hens not given ample food containing the proper nutriments cannot produce eggs.

6. It is urgently recommended that when the egg production begins to slacken in the fall the supply of feed for the hens be not decreased, for even though the hens are not producing eggs they are growing new feathers and on account of lower temperatures require more food for body maintenance.

3

BULLETIN No. 118

APRIL, 1919

New Mexico College of Agriculture and Mechanic Arts

AGRICULTURAL EXPERIMENT STATION

STATE COLLEGE, N. M.

HEADS OF COPENHAGEN MARKET.

CABBAGE CULTURE

By

JOS. W. RIGNEY

New Mexico Agricultural Experiment Station

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CABBAGE CULTURE

Introduction.

There have been many developments in the agriculture of this State during the last ten years, and several crops are now grown on a commercial scale which were either not grown at all or grown only in small gardens. This is especially true of the cabbage, in many places. Cabbage is now being shipped out of some of the valleys in carload lots where it was not grown at all on a commercial scale even five years ago.

The cabbage, being a cool weather crop, makes most of its growth early in the spring or late in the fall. The spring planting seems a little better suited than the fall in the warmer irrigated valleys, and consequently much of the labor in cultivating and irrigating comes at a time when other crops do not require so much attention. This, combined with the fact that spring cabbage usually gives very satisfactory returns per acre, promises much greatre development for the future.

COLDFRAMES.

Coldframes are so indispensable in producing early cabbage that every grower should have one. The first and most important consideration for a coldframe is its location, for its success depends largely on this feature. This is because the coldframe depends entirely upon the

sun for its heat and the action of the sash is such that it is not only warmer inside of a coldframe than outside while the sun is shining, but heat also escapes much more slowly from inside the coldframe than out when the sun is not shining. Coldframes, then, should be located where they will get the maximum amount of sunlight and also be protected from cold winds as much as possible. There is no better location than just south of an adobe wall, for the wall not only shields from the cold winds day and night, but absorbs a great deal of heat on sunny days, much of which is given off to the coldframe during the night.

Both coldframes and hotbeds should be six feet wide, outside measurement, by a multiple of three feet in length. This is because the usual size of a sash is three by six feet. The frame should run east and west and be lower on the south side than on the north, in order to have the sun strike as squarely as possible. The south side should not be so low, however, that the plants will not have room to develop. It may be about flush with the ground on the outside, but should be at least seven inches deep on the inside, on the south, and a foot or more on the north.

Some frames have a support running across every three feet which not only affords some stay for the edges of the sash, but also makes a closer fitting joint between the sash. These are not necessary in the frames for cabbage, but instead there may be a support or brace every six feet and low enough not to touch the sash at all. (See Fig. 4). The entire frame, if made of lumber, should be of material two inches thick.

The soil should be very rich, and the best way to get it properly fertilized is to put well rotted manure in the frame until it is six inches deep, and then spade it in with the six inches of soil just beneath. Then mix, level, irrigate properly, and it is ready for planting. Cabbage plants need a great deal of manure in order to develop into strong, stocky plants, for if not properly developed they

are more easily destroyed by insects and unfavorable conditions.

Fig. 1.

Spindling Plant 6 inches high.

The proper soil and seed are not the only limiting factors in growing cabbage plants in either the coldframe or the hotbed. The plants must be irrigated and ventilated. Both the irrigation and the ventilation have to be varied according to the weather conditions and the hotter it gets the more water and ventilation necessary. The plants should be ventilated every day, when the sun shines, in order to keep the air from getting stale. No set rules can be given for ventilating, but plants that are not ventilated enough will be tall and spindling, as shown in Fig. 1, and those exposed too much will not grow well and will be very low, as shown in Fig. 2. Under-ventilation also causes the plants to be a pale yellowish-green color, while over-ventilation will generally cause a purple tint. The sash should not be removed when the wind is blowing, as the plants are accustomed to a moist atmosphere and the winds rob them of moisture and cause them to wilt badly. But whenever it is warm enough the sash should be removed entirely for at least a short time. Some prop up one end of the sash, but this may cause the plants at one end of the rows to be smaller than those at the other. Raising one side of the sash is better than raising one end of it, but neither is as good as removing it.

Fig. 2

Too short for planting. 3½ inches high.

The plants will need sprinkling as soon as they begin to come out of the ground and a few times after they are up, but as soon as they are an inch

high they should be irrigated instead of being sprinkled. The irrigation wets the soil deep, so that the roots can penetrate it. This method of watering the coldframe has given good results at the Station. The frequency of the irrigation will have to be determined by watching the soil and plants. The plants should not be allowed to wilt nor the soil to become dry.

FIG. 3.
Strong, stocky plants, 6 inches high.

From one-fourth to one half an inch is deep enough to plant the seed in the frames, as the moisture of the soil can be controlled so that the germination will be almost perfect. The rows may be from four to six inches apart. It is important that enough seed be planted to get a good stand, but on the other hand it is essential that the plants should not be too thick, as this would prevent them from being stocky. So the best seed should be used, and it should be known what per cent of them will germinate and make good plants. Four or five seeds to the inch, when they are good and properly planted, is the amount that should be used. Experiments at the Station have shown that one row across the coldframe will produce about one hundred and fifty good, vigorous plants in about ten weeks. The time varies with both the temperature and the thickness of the planting, and to some extent with the variety.

GLASS SASH VERSUS CLOTH FOR COVERING COLDFRAMES.

In trying out these materials several plantings of cabbage were made and one-third of each covered with regular glazed sash, one-third with two thicknesses of cloth which had about two inches of air space between the

cloths. The cloth was stretched and tacked to one side of regular frame sash for the one thickness and to both sides for the two thicknesses. Unbleached muslin, or brown domestic, was used. The different sections were separated with partitions extending from the ground to the sash, so that the portion covered by the one thickness of cloth was not influenced by either of the others, nor was the double thickness of cloth or the glass influenced by either of the others. On January 19, 1918, the plants from the December 6 planting were from three to four inches high. During the night of the nineteenth and the morning of the twentieth about six inches of snow fell. It remained cloudy all day the twentieth. The morning temperatures at a station about two hundred feet from the coldframes were one and a half, three and a half, and ten degrees for January 21, 22 and 23, respectively. On the morning of the twenty-first it was noticed that almost all the plants showed some injury from the cold. Those covered with one thickness of cloth showed a little the most injury and there was no appreciable difference in those covered with the double cloth and the glazed sash. Only the tips of the leaves were frosted and in a few days there was no evidence of injury. When the plants were transplanted to the field, (February 15) there was no difference in them. During the cold weather in January the plants received no sunlight for thirty-six hours, in the latter part of which time the temperature went to one and a half degrees outside the coldframes; yet the ones under the single cloth finally developed into as good plants as those under either two thicknesses of cloth or glazed sash, and it seems that under the climatic conditions existing at the Station and all similar localities cabbage plants will grow as well under cloth as under glass.

HOTBEDS.

A hotbed differs materially from a coldframe in one respect. It is equipped with a medium for producing heat other than that received directly from the sun. This is generally a layer of horse manure twelve to eighteen

inches thick, but steam, water, or hot air in some cases may be used. When manure is used it should be fresh from a horse stable and should be placed in one or more large piles and thoroughly mixed once a day for four or five days after it begins heating. The mixing should be so done that the pile will be turned inside out, as the inside heats faster. If the manure is dry it will need to be wet in order to get it to heat properly. The thickness of the layer of manure is determined by the locality, but is generally never less than a foot. Regardless of the thickness of the manure needed, there should be six inches of soil on top of it for the roots of the plants to grow in. This means that if a foot of manure is needed the hotbed should be dug out eighteen inches below where the surface of the soil is to be, so that there will be room for both the manure and the soil. The manure should be packed well as it is put into the pit, and, after the proper amount is put in, it should be so leveled off that the middle will be two inches higher than the sides and gradually sloping down to them. The sides should be the same height, so that when the manure settles in the middle the entire surface will be level, and the water will cover uniformly. After the manure has been well tamped the soil should be put on uniformly six inches thick. The next step is to put the sashes on and let them stay for five or six days before the seed is planted, in order that the hotbed may warm up, and also that the gases from the heating manure may escape, as they are very injurious to the young plants. On account of being warmer and giving off gases, the hotbeds need more ventilation than the coldframes.

THE AMOUNT OF SEED TO PLANT.

Since for good, well-fertilized soil thirty by fifteen inches is a proper distance for Copenhagen Market and similar varieties, and also as it is necessary to have some basis for computing the amount of seed to be used, these distances will serve for the basis. Thirty by fifteen inches apart requires 13,939 plants per acre, if one plant is placed in each hill. There are about 8,500 cabbage seed to the

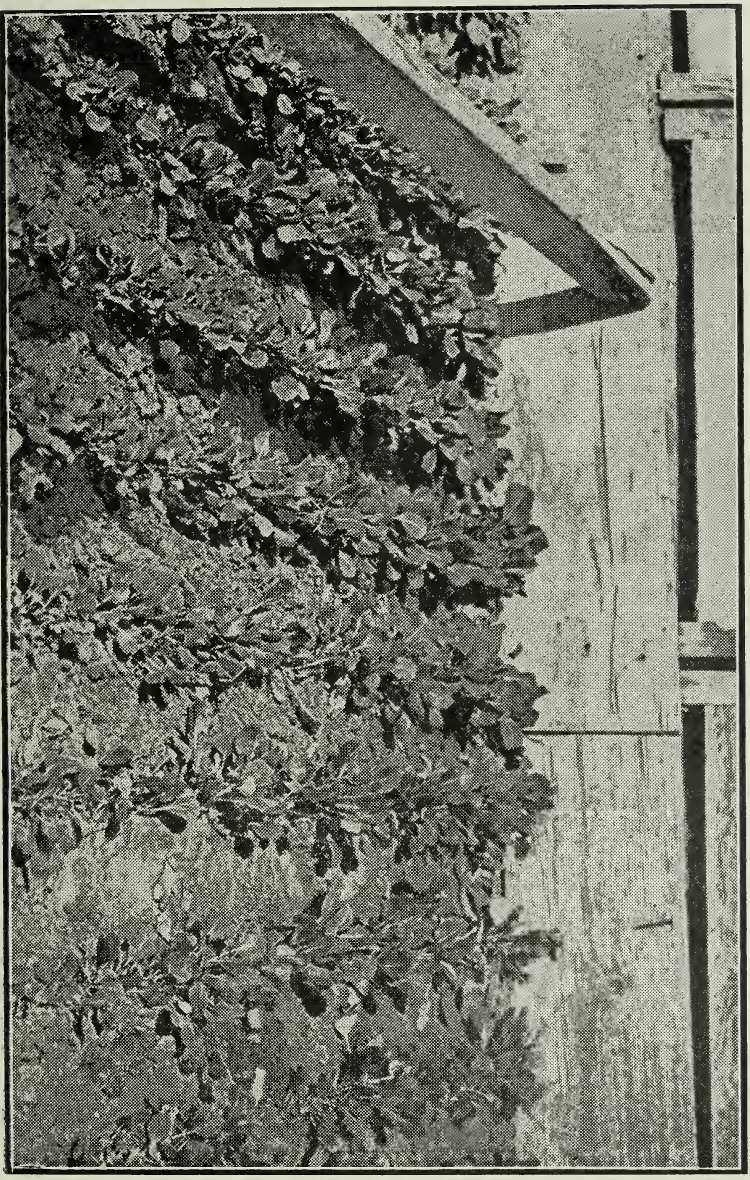

FIG. 4. 150 plants per row in cold frame.

ounce; so that where conditions are such that 75 plants are raised out of every 100 seed planted, about 6,400 plants will be grown from every ounce of seed sown. Or, in other words, it will require from two to two and a half ounces of seed for every acre to be planted. It is also well to know the amount of coldframe necessary for producing 13,900 or 14,000 plants. Four or five seed to the inch are sufficient and at this rate one row in the coldframe will produce, on an average, one hundred and fifty plants.

At the rate of one hundred and fifty plants to the row it will require ninety-two rows in the coldframe for the 14,000 plants; and with the rows four inches apart about thirty-three feet of frame will be needed. If the plants are to be further apart in the field, so much coldframe space will not be required. The seed should be planted from a fourth to half an inch deep and kept moist.

Frequent shallow cultivation should be given so long as the size of the plants will permit, for they are thick on the ground and their roots need a great deal of air.

As soon as the plants are four or five inches high they should be sheared off an inch or more. When under glass it will be necessary to repeat this operation from one to four times, depending on the time they are transplanted, as shearing makes them more stocky and also retards their growth somewhat.

TRANSPLANTING TO THE FIELD.

Both the method and the time of transplanting are important features in determining the success of the crop. However, the method is less important than the time, for the cabbage is not difficult to get started. The main object is to get the plants to the field in such a manner that they will be checked as little as possible, regardless of whether they are set on the level or on the ridge. A good way is to run a spade into the soil on each side of the rows in the coldframe, pry a little to loosen the plants and then lift them out with the hands. They may be placed in a tub partly filled with water, or one that is only moistened, and carried to the field in it. While the tub of

plants is in the field it is well to have the tub so turned that the sun will not shine directly into it. But before the plants are removed from the coldframe they should be carefully examined and if aphis or other insects are present the entire plants should be plunged into a solution of nicotine sulphate as soon as they are taken up. It is well to do this as a precaution, even if no insects are seen. The solution may be as strong as one part nicotine, (40% strength) to six hundred parts of water, and the plants left in three minutes. This is necessary on account of the insects wintering over in the coldframes on the plants, and if they are not killed they will be taken to the field on them. When put on ridges the plants should be just a little below the waterline, and whether on the level or ridges the plants should be irrigated immediately after setting.

The Time to Transplant: There is no factor connected with cabbage growing that is of more importance than transplanting at the proper time. It is also a feature which can not be considered separately and alone, since the plants must be secured in some way before they can be transplanted. They must be grown or purchased. It is very unsafe and unsatisfactory to depend on purchasing plants unless arrangements are made with some reliable grower to furnish them at some stipulated time. If the growers are to produce their own plants they must determine when to plant the seed in order to have the plants at the time needed, as well as to decide on just when the plants should be transplanted.

Seed take longer to germinate during the cold weather than the warm, the plants grow more slowly and it generally requires longer for hardening-off. It will require about a hundred days for producing plants from the fall planting and about sixty from the spring planting. But no given number of days can be relied upon absolutely, and it is better to give plenty of time and then hold the plants back by shearing and hardening.

Plants grown in the coldframes or hotbeds are tender and quite succulent and before they can be successfully transplanted to the field, must become accustomed to the field conditions, or be hardened-off. The change from the warm, moist climate of the coldframe to the cold, dry atmosphere of the field must be made gradually. This is done by allowing the plants to suffer a little for water and exposing them a little more each day to the cold until they can stand the night temperatures without any protection at all. When hardened enough in the spring they show a decided purple tint.

Taking everything into consideration, it might be said that plants can be grown to the proper size and condition for a given time with a fair degree of accuracy. In fact, it is easier to have the plants ready to transplant on a certain date than it is to determine the best date for transplanting them.

Table 1.—Showing How Different Dates of Transplanting Affect the Yield.

Variety	Date Transplanted	% Producing Marketable Heads	Ave. Weight of Heads	Date Harvested
Extra Early Express	March 19	87	1 lb.	June 18
	March 27	84	3/4 lb.	June 30
	April 16	15	4/5 lb.	July 8
Early Jersey Wakefield	March 19	96	1 1/4 lb.	June 24
	March 27	92.8	1 lb.	June 30
	April 16	7	8/9 lb.	July 20
Early Winningstadt	March 19	72	12/13 lb.	June 30
	March 27	79	8/9 lb.	July 8
	April 16	10	7/12 lb.	July 25

The table shows that the later these varieties were transplanted the smaller the percent which headed, and also the smaller the heads. On the other hand, the latest heads came about the time of the best prices. It also shows that planting ten days later does not necessarily

mean that the harvest will be the same number of days later, for in the case of the Extra Early Express a difference of eight days in planting resulted in harvesting twelve days later, while a planting twenty days still later gave a difference of only eight days in lateness of harvest. On the other hand, both the other varieties gave somewhat different results. The aphis damage the late planting less than the early, while the reverse is true of the cabbage worms. However, the worms are not as difficult to control as the aphis. The above is true for all cabbage, but not all cabbage are affected the same by late transplanting, and it is possible that there is a variety which would produce a good crop as late as the middle of July.

DISTANCE TO PLANT.

The width of the rows and the distance of the plants in the rows should be determined by (1) the market requirements of the size of the heads, (2) the kind of soil, (3) the variety, and (4) the method of cultivation.

1. The market for this section prefers about an eight-inch, solid head. Loose heads are not wanted on any market, nor are extremely large or small ones. Heads from six to nine inches in diameter represent about the range for sizes. Sizes above and below this are not so desirable. The pointed heads may be smaller than the round, and decidedly smaller than the flat ones.

2. There are many types of soil in the State, and cabbage would probably grow on all of them, but not equally well. Experiments have shown that neither the sandy nor the heavy adobe soils are as good as the loamy soil for cabbage. The adobe is better than the sandy and will grow more pounds to the acre, and in many cases possibly as many as the loamy. The loamy soil produces a more uniform crop and also more heads per acre of a given size, than the sandy. On adobe soil the heads are inclined to be larger and later. Other things being equal, the richer the soil the closer the plants will need to be, if the heads are to be prevented from getting too large.

3. Some of the early varieties are small and produce small heads, and in order to get the yield per acre they will have to be closer together. For example, the Early

FIG. 5. Packing crate to weight.

Dwarf Flat Dutch should be planted a little closer than the Copenhagen Market.

4. Where cabbage is on rich soil and is to be given frequent horse cultivation the rows will have to be wide enough for the horse, but the plants may be crowded in the row more. Plants fifteen inches apart in thirty-inch rows can be cultivated with a horse and are close enough for Copenhagen Market, on rich soil. This is closer than they should be on soils which have not received quite heavy applications of manure.

CULTIVATION.

Cabbage is grown both on the level and on ridges, but for most conditions the level is the more popular because it is easier to get the land in condition for planting on the level and easier to cultivate it. Ridges and furrows are easier to irrigate just following the transplanting, as they can be handled individually so that the plants in one row do not have to wait until another row can be set before they get water. After this first irrigation the level is the easier to irrigate although it requires a little more water. The five hoe cultivator, the spike-tooth cultivator, and the cotton sweep are good implements for one-horse cultivation.

When cabbage is planted on ridges it should be set a little below the water line, in order to be sure that the roots get plenty of water while the plants are young. The ridges should be run north and south so that the plants on each side receive about the same amount of sunlight. The soil is warmer on the south side of the ridge than on the north, and sometimes this difference amounts to as much as six degrees in the middle of the day. The ridges are more difficult to cultivate than rows on the level, or small furrows, but by using the five-hoe cultivator they can be managed very well. Small plows are put on each side and a large one in the middle. Sometimes a sweep is used on the back plow and this helps to keep the plants ridged up.

Regardless of the system of culture, the cabbage should be given frequent cultivation. After the plants

get started it is better to cultivate shallow in order to keep from injuring the roots, for the cabbage uses large quantities of plant food and consequently has many roots. Irrigations will not take the place of cultivations, for, although the plant needs a great deal of water, it must also have plenty of air for the roots. The ground should be kept moist, but at the same time the cultivations should be frequent enough to keep the plants thrifty. The cultivation should be continued until the plants are so large that the bottom leaves are being broken off frequently.

FERTILIZERS.

The cabbage, being a leaf crop, needs great quantities of plant food, especially nitrogen. The soil should be not only rich, but in the best of condition, enabling the plants to get the food readily. Some authorities object to the use of nitrate of soda on New Mexico lands because it is adding a salt to salty lands; but even so, it is not the only form in which nitrogen may be applied. Turning under alfalfa, making heavy applications of stable manure, adding ammonium sulphate, tankage, etc., are other ways in which nitrogen may be added; and all these fertilizers aid the nitrifying bacteria. The following table shows how the application of nitrate of soda increased the yield:

Nitrate of Soda at the Rate of Three Hundred Pounds per Acre.

Variety	Treatment	No. of Plants Set	No. Died	No. Failed to Head	No. of Heads	Total Wt. of Heads	Av. Wt. per Head, lbs.
Early Express	Fertilized	210	40	48	122	125 lbs.	1 1-40
	Not Fert'd	210	33	55	122	110 lbs.	4-5
Early Jersey Wakefield	Fertilized	210	34	29	147	203 lbs.	1 4-11
	Not Fert'd	210	32	46	132	169 lbs.	1 3-11
Winning-stadt	Fertilized	210	20	38	152	198 lbs.	1 7-25
	Not Fert'd	210	17	43	150	151 lbs.	1

The table shows that the nitrate of soda not only increased the percentage which headed but also caused the plants to produce larger heads. In fields where manure was also applied the cabbage made better yields and was of somewhat better quality. Where manure had been applied more than one year the cabbage was still better, showing that there is acumulative effect from the manure.

ENEMIES AND DISEASES.

To date there have been no diseases seen or reported on the cabbage; but this only means that there should be more precautions taken in order to keep them out. Common diseases of all crops generally follow close on the heels of commercial production.

There are many insects which live on the cabbage and as a rule they must be combated or quite a loss will be sustained. Both the biting and sucking insects are present, and it is difficult to determine which is really the more injurious on the whole. Generally speaking, the sucking insects are worse in the spring than in the fall and just the reverse is true of the biting kind. Occasionally both classes are found on the late spring plantings.

The aphis and the cabbage bug, also known as the calico and Harlequin bug, get their food by sucking it from the tissue of the plants and are not affected by arsenate of lead. They must be sprayed with an insecticide which kills by contact. The most practical of these are the kerosene emulsion, whale oil soap, and the nicotine sulphate. (A popular brand of the nicotine sulphate is the Black Leaf 40).

Make kerosene emulsion as follows: Dissolve three pounds of soap in a gallon of water, add this boiling to two gallons of kerosene and stir for ten to fifteen minutes. One gallon of this emulsion is sufficient for twelve to fifteen gallons of water.

Whale oil soap should be used according to directions on the package, using the strongest solution recommended

for the cabbage aphis. Whale oil soap is easily mixed and applied, is effective and safe to use.

Black Leaf 40 is supposed to be 40 per cent. nicotine and should be used at a rate of one part to six hundred parts of water; however, nicotine sulphate is sold in different strengths, a very common one being the ten per cent. If this is used it would need to be as strong as one part to one hundred and fifty parts of water.

It should be borne in mind that with all the above sprays it is absolutely necessary to cover the insects with the spray. Covering the plants with any of the above sprays will not injure sucking insects that come after the spraying is done. The contact sprays will kill the cabbage bugs when only a day or so old, and the worms until they are one-fourth grown, provided they cover the bugs and worms. Spray thoroughly as soon as insects are found.

The biting insects, such as the cabbage worms and loopers, can be controlled by poisoning, and either the liquid sprays or the dust may be used. The powdered arsenate of lead is really better, regardless of whether it is to be used in dusting or in liquid spray, but the paste form may be used. Arsenate of lead is generally more easily obtained than the Paris green, and is more satisfactory, but the Paris green, if used properly, will control the biting insects. For the liquid sprays, use a pound and a half of the powdered arsenate of lead to fifty gallons of water. For the dusting, use one pound of the powdered arsenate of lead to seven pounds of air-slaked lime. Mix thoroughly and apply to both the under and top surfaces of the leaves. Small hand-dusting machines are on the market, and those used at the Station have been found to do good work. The dust sticks to the foliage well and gives good results. It can be applied quicker and consequently at less expense than the liquid sprays.

The liquid sprays do not cover the foliage well, and run off unless a sticker is used. The following is taken from Circular 226 of the Illinois Experiment Station:

"A special resin-lime mixture recommended by F. A. Sirrine has proved very effective for sticking to the foliage. The stock solution is made from the following constituents:

Pulverized resin	5 lbs.
Concentrated lye or potash	1 lb.
Fish oil or any cheap animal oil except tallow	1 pint
Water	5 gals.

The resin, oil and one gallon of water, are heated in an iron kettle until the resin is dissolved. The lye is dissolved and then slowly added. The other four gallons are then added and the mixture boiled until it will unite with cold water making a clear amber-colored liquid. Add more water in case the solution has boiled down to less than five gallons. One gallon of this stock solution, diluted with sixteen gallons of water, three gallons of milk of lime . . . and one pound of arsenate of lead, forms a spray which adheres very readily to cabbage foliage and is effective against the worms. This spray sometimes causes a roughening of the cabbage leaves, which undoubtedly does some harm."

Milk of lime is made by adding three pounds of quick lime to three gallons of water.

MARKETING.

Marketing cabbage, as with most of the agricultural crops, seems to be one of the most difficult operations connected with it.

Cabbage is well adapted to the irrigated valleys, where it has been grown for a long time on a small scale. During the last few years carload shipments have been made from the Mesilla Valley, for example; but it has been grown commercially for only a short time in this region. In the first place, the growers were not acquainted with the method of packing which the consumers of cabbage from this district demanded. Some tried sacks for packing, but it was learned that the standard cabbage crate as used by the California growers, has been the pack that seems to take with the consumers. Regardless of the product to be marketed, the first thing to do is to find where it is to be sold and what kind of a package is demanded by that market; and, above all things else, use this package. However, the selling of crops is more or less of a specialized business and better results can be had by making use of the specialists along this line. No one else can secure the sales and get the prices as well as

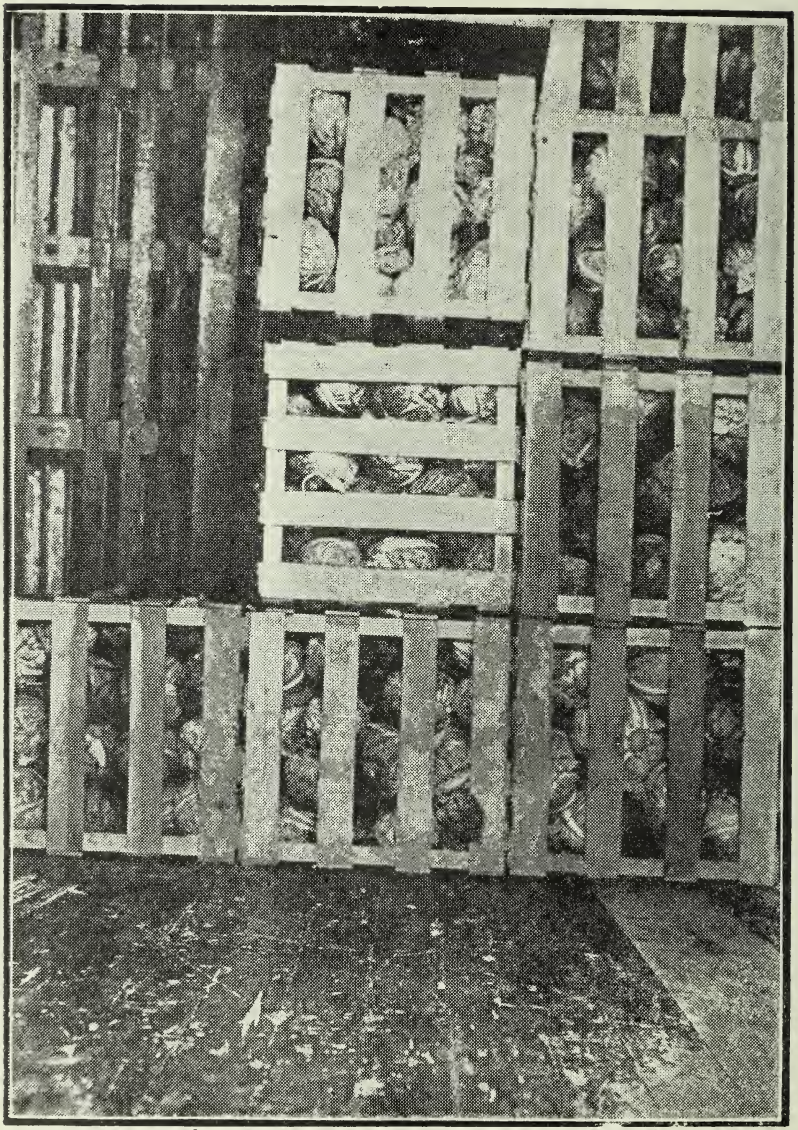

FIG. 6. Showing the beginning of load in corner of Refrigerator Car.

a good, reliable commission man. There is at least one in the reach of any cabbage production center, and he is only too anxious to give instructions about the harvesting and delivery of the crop to the railroad point. Both the county agents and the farm bureaus can give valuable aid in finding and dealing with the proper commission man. Where it can be done it is better to contract to have the cabbage received in bulk at the packing shed and allow the commission man to have it packed as he wants it.

VARIETIES.

A number of varieties are on the market and it is not possible to name one that would be best for all localities. This is because there are so many different climatic conditions in New Mexico and also because all the growers do not handle the crop in the same way. Varying the cultivation and irrigation cannot change the form of the head, but may cause some difference in the time required for maturing the crop and also cause the heads to be larger or smaller, more or less compact, or firm. Following are some of the varieties which have given good results at the Experiment Station:

EARLY.

Copenhagen Market (round head).
Early Jersey Wakefield (pointed head).
Winningstadt (pointed head).
Early Dwarf Flat Dutch (flat head).
Early Express (pointed).

LATE.

Large Late Drumhead (flat head).
Premium Flat Dutch (flat head).
Short Stem Drumhead (flat head).
Danish Ballhead (round head).

The Copenhagen Market has become the most popular commercial, early variety in the Mesilla Valley, where it is being grown extensively and shipped in carload lots. It is a medium-sized plant, round head, which under local conditions grows quite firm and hard, splendid quality and a good producer. They begin shipping this va-

riety about the twenty-fifth of June and continue until July tenth, on an average.

Figure 7 shows twelve of the varieties which have been tried in the experiments. They are, beginning at the left in the top row: Large Late Drumhead, Premium Flat Dutch, Short Stem Drumhead, Danish Ballhead, Early Dwarf Flat Dutch, and Sure Head. The bottom row in

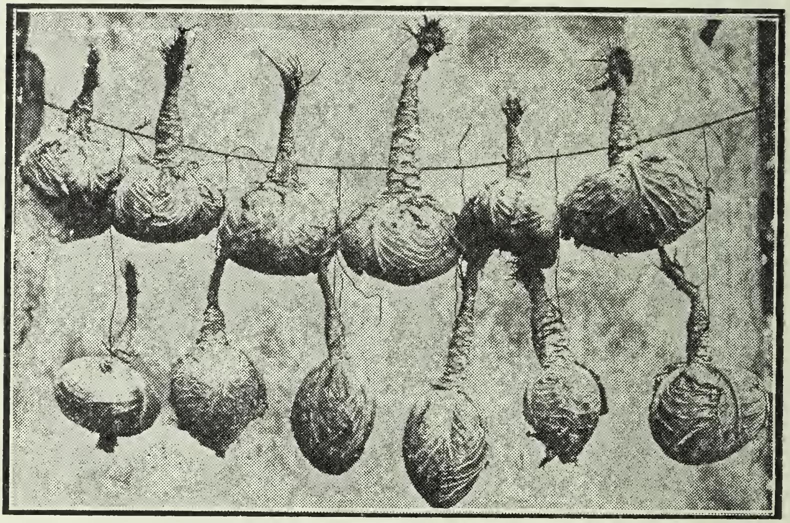

FIG. 7. Types of twelve of the varieties tried.

the same order are: All Head Early, Early Jersey Wakefield, Extra Early Express, Extra Early Etampes, Early Winningstadt and Copenhagen Market. These, along with Autumn King, Late Premium Flat Dutch, Early York and Sure Head were planted in the coldframes May 25, and the plants were nice and stocky when transplanted to the field July 15. The photographs were taken October 30, 107 days after transplanting, and only the twelve first named were satisfactory.

Following is a list of the varieties and the percent of each which had produced marketable heads in 107 days: Large Late Drumhead, 26 per cent.; Premium Flat Dutch,

26 per cent.; Short Stem Drumhead, 49 per cent.; Danish Ballhead, 41 per cent.; Autumn King, 20 per cent.; Early Dwarf Flat Dutch, 74 per cent.; Sure Head, 41 per cent.; All Head Early, 43 per cent.; Early Jersey Wakefield, 40 per cent.; Extra Early Express, 34 per cent.; Extra Early Etampes, 35 per cent.; Late Premium Flat Dutch, 32 per cent.; Copenhagen Market, 43 per cent. The Large Late Drumhead, Premium Flat Dutch, Shortstem Drumhead, Danish Ballhead, and the Autumn King had, besides the marketable heads, a number of heads which were a little small and loose, indicating that these varieties did not have quite time enough. Most of the Early Dwarf Flat Dutch could have been harvested by the middle of October, or 92 days after transplanting, but it was still in good condition when harvested on the fourth of November.

Plants for the fall planting were transplanted the fifteenth of July and Table 1 shows that the spring planting is usually harvested before this time; thus it is possible to grow two crops of cabbage on the same land in one season in the warmer valleys of the State. Table 1 also shows that the spring planting, on the average, gives a much greater percentage of marketable heads, except where the transplanting is done so late that much of the growing season is during the hot weather.

The spring crop has given better yields at the Experiment Station than the fall, but in the higher altitudes of the State only one crop can be grown, as the season is shorter.

SUMMARY.

1. Coldframes are well adapted to starting cabbage plants for early planting.

2. Early cabbage may be started as well under cloth as glass.

3. One ounce of seed (8,500) is sufficient for about 6,400 plants. One row in the coldframe should produce 150 good, strong, stocky plants. And 14,000 plants are needed for an acre, where plants are 15 inches apart in rows 30 inches wide.

4. The plants should be well hardened-off and stocky, and before being transplanted to the field should be dipped into a strong solution of nicotine sulphate to free them from insects.

5. In the spring late transplanting gives proportionately late maturing up to a certain time, after which tardiness in transplanting causes extremely late development and may even result in a failure of crop.

6. The later the transplanting in the spring the smaller the yield.

7. Cabbage needs a rich, loamy soil and should not be planted on either sandy or gravelly soils. It responds well to nitrogenous fertilizers.

8. Level culture is easier and more common than ridge. If planting is to be done on both sides, the ridges should run north and south.

9. The cabbage has many insect enemies, but as yet, no diseases are of economic importance.

10. The aphis damage the spring crop more than the fall, and the earlier the crop the greater the damage to be expected. Worms are more severe on the fall cabbage, but injure the late spring plantings to some extent also.

11. Cabbage growers should have on hand adequate materials and equipment for controlling the aphis every spring and begin combating them as soon as they appear.

12. Dusting is an effective means of controlling the cabbage worms. The dust sticks better than the liquid sprays and can be applied more quickly and cheaply.

13. Best returns can be got by marketing through reliable commission men, in car-load lots.

14. There are many varieties which do well, but only one or two should be grown in a given locality. The Copenhagen Market is the leading variety in the Mesilla Valley at present, but one of as good quality and as productive which would mature later in the spring would be better.

15. A spring crop of cabbage can be followed by another on the same land in the fall in the lower, warmer valleys of New Mexico.

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AGRICULTURAL EXPERIMENT STATION

STATE COLLEGE, N. M.

Sorghums for Silage and Hay

BY

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NEW MEXICO AGRICULTURAL EXPERIMENT STATION

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SORGHUMS FOR SILAGE AND HAY

INTRODUCTION

In recent years the growing of the sorghums in New Mexico has increased until they rank among the most important crops. In 1918 there were some 200,000 acres of sorghums planted in this State, with an estimated value of over $6,000,000.00. This increase in popularity is due largely to the fact that careful tests and general farm experience have shown that the sorghums are more profitable than corn in many of the dry farming districts, for they are very much more drouth resistant than corn and have a habit of adapting themselves to more or less liberal supplies of moisture, "celling up" their sap during excessively dry periods and then resuming growth and development when rain comes. Another reason for their increased popularity is the fact that in the irrigated valleys they may be used as catch crops. When poor seed or any other cause prevents a good stand of corn or other crop, sorghum is a valuable substitute. It grows well during hot weather and will often make a good yield of forage even though planted as late as the last of July. Almost all of the members of the sorghum family make a good quality of silage, provided they are harvested and ensiled at the proper stage of growth. Heavy yields are usually secured from some of the rank growing varieties, which make them popular as a silage crop.

This bulletin is written for a large area of country in which there is a wide variation in elevation, temperature, length of season and rainfall, and the statements applying to one set of conditions do not necessarily apply to others.

HISTORY AND CLASSIFICATION OF SORGHUMS

The sorghums have been cultivated since prehistoric times. In the United States broom corn sorghum was grown in colonial times and the first sweet sorghum was introduced in 1853 from France, the first introduction closely resembling the variety now known as Amber. This variety was widely distributed in 1857 by the United States Patent Office and since that time numerous varieties and types have been introduced, chiefly by the United States Department of Agriculture. No other cultivated crop exhibits so great a diversity as does sorghum. Varieties have been developed for three distinct purposes; namely, grain, sugar, and broom-straw. All of these groups also produce forage as a by-product and, in fact, many varieties are now grown primarily for their forage.

In America probably three-fourths of the herbage produced by all the sorghums is consumed as coarse forage. The sorghums are sometimes classified into saccharine and non-saccharine groups, depending on whether they contain sugar in the stalks; but probably a more suitable classification is one based on the use to which the plant is put. There are four distinct groups under which the plant is put. They are:

(1) The grain sorghums,
(2) Sorghums for forage or syrup,
(3) Sorghums for hay, and
(4) Broom corn.

Some of the varieties to be found in the different groups are named in the following outline:

1. Grain Sorghums (those grown primarily for grain).
   - (a) Standard Black hull Kafir.
   - (b) Dwarf Black hull Kafir.
   - (c) Red Kafir.
   - (d) White Kafir.
   - (e) Pink Kafir.
   - (f) Standard Yellow Milo.
   - (g) Dwarf Yellow Milo.
   - (h) White Milo.
   - (i) Feterita.
   - (j) Kaoliang.
   - (k) Brown Durra.
   - (l) Shallu.

2. Sorgo, or sweet sorghum (those used for forage and syrup).
    (a) Black Amber.
    (b) Red Amber.
    (c) Sumac or Redtop.
    (d) Orange.
    (e) Texas Seeded Ribbon Cane or Gooseneck.
    (f) Japanese or Honey.
3. Sorghums for Hay.
    (a) Sudan Grass.
    (b) Johnson Grass.
    (c) Tunis Grass.
    (d) Black and Red Amber.
4. Broom Corn.
    (a) Standard.
    (b) Dwarf.
    (c) Dwarf Standard.

SORGHUM AS A DRY LAND CROP

As has been previously stated, the sorghums are not indigenous to this country but have been introduced from foreign countries. These "immigrant" crops, as they are spoken of by Dr. C. R. Ball of the United States Department of Agriculture, "are largely responsible for the present prosperity and wealth of Kansas, Oklahoma and Western Texas, for during the early days of settlement, when years of deficient rainfall and drouth caused the corn and other crops to fail and the settlers were being forced to abandon their new made homes, the sorghums were introduced and farm settlement took a fresh start. Settlers returned to their abandoned farms, and towns and cities began to spring up in places where sand hills and sunflowers had held forth."

Because of their drouth resisting qualities the sorghums have won a permanent place in the cropping system of the dry land farmer. Corn is not a safe crop in many of the dry farming districts of the State, mainly because of its exacting water requirements. The crop requires for its best development a very large supply of soil moisture during a comparatively short period of growth. Corn has very little ability to adjust its growth to conditions and wait for rain. Sorghums, on the other hand, have this ability, and therefore are a much more dependable crop in periods of extreme drouth than corn. They cannot be success-

fully grown in some localities because of the cold climate resulting from the high altitudes.

Two kinds of sorghums are commonly grown. Both have about an equal resistance to drouthy conditions. These are the feed, or saccharine, sorghums; and grain, or non-saccharine, sorghums. The juices of the latter are not so sweet as those of the saccharine group, and they are often called grain sorghums because they produce heavy yields of seed or grain which is well adapted for feeding purposes.

There are some varieties in each group which by the habit of their growth are better suited to extremely dry regions than others.

Freed, or White Amber, sorgo is perhaps the earliest and surest of all forage sorghums. It is valuable for late planting but is a relatively light yielder.

The Black and Red Amber sorgos are moderately early, and under normal conditions will outyield the Freed, but are not so sure in abnormally dry years.

The Orange sorgos are valuable for forage, but are later than the Ambers, and therefore not so well adapted to regions of very limited rainfall or for late planting.

Sumac sorgo, also known as Redtop, is a large, late maturing variety, and for this reason is not so widely grown in the dry farming areas of New Mexico; but where conditions are such that it can be grown it produces heavy yields of forage.

Of the grain sorghums milo is probably the most extensively grown, because it is hardier and will grow and mature at higher elevations than the other varieties. Milo makes a good yield of grain, but the roughage from it is usually not so good as the roughage from kafir.

Kafir requires a somewhat longer season than milo, and for this reason is not quite so sure a crop. Wherever there is sufficient moisture and time for it to mature it gives good yields of grain and the forage is of good quality. It is usually more easily harvested than milo. Feterita does not seem to have any

desirable characters that are not possessed by milo and kafir, and so far has not become a very popular crop with the dry farmers of the State.

Fig. 1—Sumac Sorgo Grown Under Irrigation at the New Mexico Experiment Station During 1918.

SORGHUMS AS AN IRRIGATED CROP

The sorghums are not grown as extensively under irrigation as they are under dry farming, due to the fact that corn can usually be grown with equal success under these conditions. In the past few years, however, there has been an increase in the acreage planted to these crops. Some of the larger type varieties of the saccharine or forage group give heavy yields of sil age, and for this reason are becoming more popular with the dairymen in the irrigated valleys. The Japanese and Gooseneck

varieties are rank growers and usually produce more tons of silage per acre than corn.

The sorghums are also being used quite extensively in the warmer irrigated sections as a catch crop following small grain, and in some instances where corn has failed for some reason or other, some of the sorghums can be grown successfully. Almost all varieties can be planted after grain harvest and yet have sufficient time to produce a silage crop and some of the short season varieties, such as the Ambers, can be planted much later.

SORGHUM AS A HAY CROP

Some varieties of the saccharine sorghums produce heavy yields of hay which is both palatable and nutritious and is readily eaten by horses, sheep, and cattle. In the irrigated regions, or where moisture is plentiful, the sorghums when intended for hay are usually sown broadcast or seeded with a grain drill. Thick seeding produces more slender stalks, which are better suited for feed. The two most popular varieties for hay are the Amber, which is an early maturing strain, and the Sumac or Redtop, which is somewhat later.

Sudan grass, although usually treated separately, is a member of the sorghum family, and is well adapted to a wide range of conditions. This crop produces heavy yields of hay, both under dry farming and irrigated farming conditions. It will produce a good crop of hay in a comparatively short time, and is able to withstand considerable dry weather. In the warmer valleys, where water for irrigation is available, three or four cuttings per season can be secured. Sudan grass can be grown at higher elevation than other members of the sorghum family. This crop is usually grown in cultivated rows in the dry farming districts.

The Experiment Station has secured yields as high as 7 1-4 tons per acre per season of air dry hay under irrigation, and Sudan grass planted as late as August 1 has given a good cutting of hay.

The New Mexico Experiment Station has been conducting a variety test of sorghums the past four years, in order to compare the yielding qualities of the saccharine and non-saccharine varieties for silage. Table I. gives the annual yield and the averages for the varieties tested in the saccharine group. As will be seen the Japanese variety gave the greatest tonnage of silage and

Gooseneck ranked second. Some of the farmers in the Mesilla Valley report yields of 25 tons of silage from the Japanese variety.

TABLE I. VARIETY TEST OF SWEET SORGHUMS

Variety	Yield in Pounds per Acre					Yield in Tons per Acre
	1915	1916	1917	1918	Average	Average
Japanese			15,345	43,240	29,292	14.64
Gooseneck			19,230	28,360	23,795	11.89
Sumac	28,680		14,640	20,600	21,307	10.65
Orange		14,265	12,045	32,100	19,470	9.73
Minn. Amber			16,350	22,120	19,235	9.61
Black Amber	11,179		5,790	40,000	18,989	9.49

Table II. gives the annual yield and the averages for the varieties tested in the non-saccharine group. Standard Black hull Kafir was the highest yielder. This variety produces a very uniform crop that is quite easy to harvest. The heads are large and it makes a very desirable quality of silage. In the irrigated sections where plenty of moisture is available the heavier yielding varieties of the saccharine group are to be preferred, however.

TABLE II. VARIETY TEST OF GRAIN SORGHUMS

Variety	Yield in Pounds per Acre					Yield in Tons per Acre
	1915	1916	1917	1918	Average	Average
Standard Blk. H. Kafir	19,856	9,006	25,200		18,020	9.00
Red Kafir		7,680	7,200	23,440	12,773	6.38
Standard Milo	17,333	6,352	8,480		10,722	5.36
Feterita	9,554	4,798	8,550	13,760	9,165	4.58
Dwarf Kafir	12,844	8,542	5,858		9,081	4.54
Dwarf Milo	11,384	7,242	6,150		8,258	4.13
Brown Kaoliang	10,393	5,886	2,190	11,200	7,417	3.71
White Durra	7,440		7,845		7,642	3.82

Table III. gives the yields of all the varieties tested in both saccharine and non-saccharine groups.

TABLE III. VARIETY TEST OF GRAIN AND SWEET SORGHUMS

Variety	Yield in Pounds per Acre				
	1915	1916	1917	1918	Average
Dwarf Milo	11,384	7,242	6,150		8,258
Dwarf Kafir	12,844	8,542	5,858		9,081
St. B. Hull Kafir	19,856	9,006	25,200		18,020
Black Amber	11,179		5,790	40,000	18,989
Feterita	9,554	4,798	8,550	13,760	9,165
Sudan Durra	5,676				5,676
Brown Kaoliang	10,393	5,886	2,190	11,200	7,417
Standard Milo	17,333	6,352	8,480		10,722
Sumac Sorgo	28,680		14,640	20,600	21,307
White Durra	7,440		7,845		7,642
Orange		14,265	12,045	32,100	19,470
Rocky Mt. Amber		10,576			10,576
Red Kafir		7,680	7,200	23,440	12,773
Shallu		9,370			9,370
Minn. Amber			16,350	22,120	19,235
Jap. Cane			15,345	43,240	29.292
Gooseneck			19,230	28,360	23,795

GROWING SORGHUMS

The cultural methods that should be followed in growing sorghums will differ with the locality, soil, and purpose for which the crop is grown. When sorghum is grown for grain or silage it is generally sown in rows and handled about the same way as corn. If grown for hay it is usually either drilled or broadcasted and handled like small grain or millet.

The ground should be thoroughly prepared either by plowing or listing. Because sorghum will grow better than most crops with poor methods it is often neglected; however, it responds to good care just as much as do other crops. In the dry farming sections fall preparation of the seed bed is, as a rule, preferable to spring preparation. Deep plowing or listing in the fall helps

to store moisture. In sections where the soil blows badly, the land should be left rough. A cloddy surface is usually a good protection against blowing. Listing will help to prevent blowing, and keep the snow on the field, and this increases the amount of moisture taken up by the soil.

Sorghum will grow on almost all types of soil, but does best on a rich loam. It will grow on land that is practically water logged and in soil that contains considerable alkali.

Fig 2—Red Kafir Grown Under Irrigation at the New Mexico Experiment Station During 1918.

SEEDING

Sorghum should not be planted until the soil is thoroughly warm in the spring and usually a little later than corn. Early seedings often give poor stands. Later seedings can be made at

any time in the summer, provided there is sufficient moisture and time enough to mature before frost.

The proper date to plant will depend on the locality, available moisture, variety to be planted and the purpose for which it is intended.

Sorghums are either planted in rows and cultivated or sown broadcast or with a drill. When planted in rows the widths vary from 18 to 44 inches and the thickness in the rows may also be varied. The rate of seeding will depend on available moisture, and what the crop is to be used for. Thick seeding will produce fewer coarse stems and more leaves, but in the dry farming section where the moisture is often very limited thin seeding is usually more satisfactory.

Where plenty of moisture is available and the crop is intended for hay it is often sown broadcast. This makes fine stems and a better quality of hay than when grown in cultivated rows.

HARVESTING

Sorghum in cultivated rows is harvested much the same as corn, when intended for silage or fodder. The row binder or corn knife can be used successfully.

When sown broadcast or in close drills it is usually cut with a mower and cured in the field in cocks, as is the case with other hay plants. When intended for hay it is usually cut when the seeds are in the early dough stage, but experiments indicate that well matured sorghum makes better silage than when it is cut earlier.

In a three-year feeding test at the Kansas Agricultural College with beef and dairy cattle it was demonstrated that silage made from the sorghums has about the same feeding value as corn silage.

SEED SELECTION

Sorghum cross-fertilizes readily and this almost always produces an inferior crop. Hybrids never produce plants true to type and are, therefore, undesirable. Foreign heads and hybrids should be removed each year, and sorghum that is intended for seed should be grown at least 40 to 50 rods from another variety that is apt to bloom at the same time.

The use of pure seed of good quality for planting is more important for sorghum than for most other crops. Field selection of seed should be practiced and only those heads that are true to type should be chosen, and from strong, upright stalks. Loose,

open heads should not be used for seed. The head should extend well out of the boot.

DISEASES OF SORGHUMS

The two most common diseases of sorghums in the State are the grain or kernel smut and the head smut.

The Kernel Smut affects the individual grains and all or nearly all the seed in the head is destroyed, but the appearance of the head is but slightly changed. The kernel smut can be treated with formalin in the same manner as recommended for wheat except the 1 pint of formalin is used in 30 gallons of water and the seed is soaked for one hour.

The Head Smut destroys the entire head, which as it emerges from the sheath is practically a mass of smut spores covered with a whitish membrane, which soon bursts and sets the spores free. There is no satisfactory treatment for head smut, as the spores are thought to live over in the ground and on the stalks.

Fig. 3—Japanese Sorgo Grown Under Irrigation at the New Mexico Experiment Station During 1918.

The following articles refer to sorghum production in some of the dry-farming sections of New Mexico:

UNION COUNTY

Union County, lying in the northeast corner of New Mexico, is a blending of the Panhandle on the east and the Rocky Mountains on the west. The elevation varies from 4,500 on the east to 6,500 feet in the north and west. The rainfall averages about 16 inches for the year and falls mostly during the growing season. The growing season, free from frost, extends from May 15 to October 1. The soils of this section vary from heavy clay to the coarse sandy soil.

Sorghums, both the saccharine and non-saccharine, are grown successfully and quite extensively in this County on all the different types of soil. The non-saccharine are grown at the lower elevations, not to exceed 5,500 feet. The saccharine are hardier and are grown at all elevations and in every part of the County. Non-saccharine sorghums are grown principally for fodder.

Of the non-saccharine sorghums milo is most extensively grown. It is hardier and will grow and mature at a higher elevation than the other varieties. It is often grown at an elevation of 6,000 feet. The white, red, and cream varieties are grown. Milo makes an average yield of about 1,500 pounds of grain to the acre, while many fields produce as much as 3,000 pounds.

Kafir ranks next to the milo in number of acres grown, but is not so hardy. It is later in maturing and often is killed by frost. The red and black hulled varieties are the principal ones grown. Feterita and a few of the other varieties are grown to some extent but do not prove as profitable as milo or kafir.

Of the cane or saccharine the Black Amber, Redtop, or Sumac, and Orange are most widely grown. These varieties make heavy yields of fodder and are grown to a large extent. Cane is considered a sure crop and nearly every farmer plants a few acres to insure having feed for the livestock. Some is grown for sorghum molasses and some for seed, but the bulk is grown for feed.

Sorghums need a great deal of plant food and moisture in a short time, but their requirements in these respects are not quite so exacting as are those of corn. Deep plowing or listing is, therefore, necessary to provide a soil reservoir for storing moisture and to provide ample feeding space for the roots. Plowing or double listing is the best method of preparing the seed bed and should be done in the fall, winter or early spring. If plowed in the spring, some method of packing the sub-soil is generally avisable. Surface cultivation in the spring should be practiced to preserve a mulch and to kill weeds until planting time.

Non-saccharine sorghums should be planted between May 20 and June 15. The saccharine varities can be planted later and many times mature when planted as late as July 20. They should, however, be planted some time in June or early July. The rate of seeding non-saccharine sorghums varies from 2 to 3 pounds to the

acre. They are planted in rows from three to three and one-half feet apart.

The saccharine varieties are planted both in rows and broadcast. When seeded broadcast it is cut with a mower and used as hay. The rate of seeding is four to ten pounds to the acre, when planted in rows, and twenty to forty pounds when seeded broadcast.

Sorghums require the same cultural methods as corn. The first, and many times the second, cultivation can be given with a spike tooth harrow. After that the row and two-row cultivators are used. Sorghums require from three to five cultivations, depending on the season.

The harvesting is done by cutting with a row binder or by heading. When cut with a row binder the whole plant is bound and is usually fed whole to the stock. When headed it is either fed in the head or threshed and sold for seed or feed.

ORREN BEATY,
County Agricultural Agent.

CURRY COUNTY

Introduction: The Grain Sorghums are the reliable crops to grow in Curry County, for when all other crops have failed the sorghums have defied the drouths and saved hundreds of farmers and stockmen from disaster. Farmers have learned to rely on these crops and ever since farming was started here they have taken the lead. Peculiar adaptability to drouth conditions common to this County and their excellent qualities both as a grain and forage crop have made them the most popular crops grown in the County.

Soil: There are two distinct types of soil in this County; the loose or sandy soil, containing a very high percentage of sand; and the tight land which contains a larger percent of clay but is really a sandy loam.

The grain sorghums seem to be equally adapted to either type of soil, but the tight land is better suited to wheat growing, and therefore more diversified farming is found on this type.

Preparation of the Soil: The first breaking of the soil is done with a sod plow and is usually about three inches to four inches deep. It is the common opinion among farmers that the first breaking should be shallow, but demonstrations do not bear out this opinion. The writer has seen several excellent crops raised on land broken deep the first time. However, time of year, condition of soil, and after treatment may have a great deal to do with final results. After the first breaking the lister is used almost exclusively. The work can be done a great deal faster than with a plow and results seem to be fully as good, with the added advantage that the soil does not blow so badly when listed. Results show that the listing should be done in the fall or winter, thus leaving the soil open to take in all moisture that may fall before planting time. Unless the weeds get bad or the soil starts to blowing, it is not disturbed any more till planting time.

Planting and Cultivating: The planting is done by means of a planter attachment of the lister. The team is driven so that the lister shovel follows the ridges, thus breaking them out and at the same time planting the seed in the bottom of the new row, leaving the young plant, when it comes protected from the winds and in a position to catch all the moisture that falls. The rows are about forty inches apart and the plants three feet apart in the rows. When the young plants are large enough to be plainly seen, cultivation should begin, in order to kill the young weeds and to form a mulch to conserve moisture. The cultivations should continue throughout the season or until the crop is so large that weeds are choked out and the ground is thoroughly shaded.

Rainfall: The average rainfall in the County ranges from sixteen to twenty inches annually. However, this is not distributed equally over the County; it often happens that some portions will get heavy rains while others will get little or none at all. Especially is this true during the summer.

The summer rains seem to be the salvation of the sorghum crops. Often during a prolonged drouth they will stand in the rows all curled up and apparently dead, but when the heavy rains come in July and August they take on a very rapid growth and seem to make the very best use of every drop of moisture. In this respect they are unlike most other crops.

Varieties: The chief sorghums grown here, in the order of their importance are: Kafir, Milo, Cane, Broom Corn, Feterita, Sudan Grass and Hegari.

The dwarf varieties of Kafir and Milo predominate, as they seem to stand the drouth better and give higher yields of grain. The Kafir, while giving a high yield of grain, also produces a forage which is relished by all kinds of stock. Milo, on the other hand, is valuable chiefly for its grain; as the foliage is scant and the stalks are pithy and contain very little of the juices.

Cane is used almost exclusively as a stock feed. It grows rapidly during the rainy season and will stand a great deal of drouth. The forage contains a high percentage of sugar and is relished by all classes of livestock.

Broom corn is grown almost exclusively for its straw and is used as a cash crop. Its greatest advantage lies in its rapid growth and quick maturity. It is often planted after some other crop has failed, and produces good brush. During the recent feed shortage broom corn stalks have been used for stock feed.

Sudan grass is grown both for seed and forage. When moisture conditions are right it will make two crops. The first crop is used for hay, while the second will often produce a good crop of seed, and due to the large amount of foliage it produces, makes a fairly good feed after the seed is threshed out. The production of seed has been a profitable business with several farmers.

Feterita seems to stand the drouth better than any of the other varieties and will mature in from 90 to 100 days. Therefore, it is very seldom affected by the frosts which often injure the more slow

maturing varieties. The chief disadvantages of Feterita are that it is very difficult to get a perfect stand and it shatters badly in handling.

Hegari has only been grown in this County during the last two years, but it bids fair to become one of our most popular grain sorghums. The forage is about the same as that of Kafir and the grain yield is fully as heavy, while it has the advantage of maturing in much shorter time, thus avoiding the early fall frosts which are so disastrous to the Kafir.

Smut: Smut is the worst enemy of the grain sorghums and it claims a heavy toll each year. It was estimated by Dr. Martin, Government expert, that the sorghums in this County contained about ten per cent smut. Farmers, however, are beginning to use the formaldehyde treatment and it is hoped by this means to eradicate this disease.

Improvement: The grain sorghum crops can be greatly improved and the yield increased, by making careful seed selection in the field and by grading and testing the seed. Many failures and partial failures have been traced to poor seed.

E. PETERSON,
County Agricultural Agent.

QUAY COUNTY

General climatic and topographical conditions make this County very well adapted to the production of grain and forage sorghums, especially the latter. The sorghums have so successfully competed with other crops that they are the principal crops grown at the present time. The altitude of that portion of the county lying between the Staked Plains on the south and the hilly section to the north and northwest is about 4,000 feet, while that of the Plains section is about 500 feet higher. The soil at the lower elevations is in general a fine sand, gradually blending into a clay which extends to considerable depth. Over considerable areas, however, this clay formation is found at the surface, or within a few inches of it, making a soil quite difficult to till. The soil on the Plains is called by the settlers "tight land." It is a dark sandy loam which does not blow readily and is a deep soil. There is more run-off of heavy or torrential rainfall from it than from the sandy soil, and a greater proportion of the rainfall is lost by evaporation from the surface. It is very fertile and with sufficient rainfall will produce excellent crops. The native vegetation on the sandy land consists mostly of mesquite bushes, yucca, sage brush and some mesquite grass and bunch grass, while the vegetation of the tight lands of the Plains is almost pure short grass.

The average precipitation for the last 14 years at the Tucumcari Experiment Farm located three miles northeast of Tucumcari is 15.97 inches. The distribution of the total yearly precipitation is often unfavorable, and the variation between points in the Coun-

ty only 15 or 20 miles apart will quite frequently amount to several inches. At the Experiment Farm the evaporation from a free water surface for a period from April 1 to October 1 in 1914 was 49.920 inches, and for the same period in 1918 reached a total of 64.423 inches. The average evaporation for the past six years, 1913 to 1918, inclusive, has been 57.316 inches. The average frost-free period at the Experiment Farm is 183 days, but on the Plains the growing season is probably a few days shorter. Temperatures get too high at times for the proper growth of sorghums, but hot winds are not so prevalent here as in some other portions of the Great Plains. The average date of the first killing frost in the fall at the Experiment Farm is October 24.

Types of Sorghums Grown

Varieties of both the saccharine and non-saccharine sorghums, or sorgos, are grown, but the former class is probably the more profitable and better suited to conditions in this County. The principal saccharine sorghums, or sorgos, are Black Amber, Red Amber, Sumac, and Freed's Sorgo. Black Amber and Red Amber are by far the most commonly grown. Sumac, because of its heavy yielding qualities on the sandier soils, is increasing in favor with many farmers and stockmen. Where the soil is suited to its growth it makes an excellent silage crop, because of the heavy tonnage produced and the heavily leaved, sweet, juicy stalks. This sorgo, however, is not a good one on the "tight land" sections of the County, except in very favorable years. During the three dry years, 1916 to 1918 inclusive, the average yield of this sorgo on the Experiment Farm has been 9,800 pounds of fodder per acre. On the soils which do not take up rainfall readily the Ambers are the best sorgos to plant; and to feed as dry roughage they are the best for any section of the County. Freed's sorgo is commonly called white cane, or white Amber, and is only grown to a limited extent, principally as a short season energency crop when the more commonly grown sorgos have failed to make a fair stand. It is a very quick grower and produces grain that is of fair quality for feed purposes. The stover, however, is poor as compared to that of other sorgos, as it has a tendency soon after the grain reaches maturity to shed the few leaves it possesses.

There are only two grain sorghums that are grown to any extent in the County. These are Dwarf Yellow Milo and Dwarf Black Hulled White Kafir. There is little difference in their average production of grain, but kafir makes the heavier crop of forage. There is little question but that these two grain sorghums are the best adapted to conditions in this County of any varieties available. It it not every year, however, that these crops produce profitable yields of grain. In years of drouth they fail more or less completely according to the severity and continuance of the drouth. The production of grain sorghums is so much more uncertain than that of forage sorghums that they will undoubtedly continue to rank second to them in favor. Feterita is grown to some extent, but its place

is like that of Freed's Sorgo—principally that of an emergency crop to be planted when the season is getting late and a good stand of milo or kafir has not been secured.

Time of Planting

There is a tendency on the part of many to plant too early, with the result that quite frequently the work has to be done over and the cost of producing the crop is greatly increased. No planting of sorghums should be done before May 15, and on the sandy soil it would be better, as a rule, to wait until June 1. By the latter date there is little danger of the tender plants being cut off or covered by drifting sand. The soil is also well warmed at this time, and if moisture conditions are favorable the crop will make a rapid growth from the start. Another important reason for deferring the date of planting is that weeds can be killed more economically before planting than after. The Russian thistle is the worst weed pest. While young it can be easily disposed of, but if allowed to get a good start it is more difficult to handle and cultivation is, therefore, more expensive and less efficient. Any growth of weeds takes from the soil water that is needed by, and would otherwise be available for, the crop.

Cultural Methods

Listing is the method almost universally followed for the preparation and planting of sorghum land. The land is generally listed in early spring or at any other time that the work can be done, and then re-listed at seeding time. Sometimes spring rains are so late in coming that the land can be listed only once. The advantages claimed for listing are that weed growth is more easily controlled and that it stops soil blowing. The stopping of soil blowing on very sandy soil, however, is only temporary; and if high spring winds continue, as they generally do until about May 1, the ridges will be leveled and blowing resumed. The growth of the crop in lister furrows is usually never so rapid at first as that surface planted on plowed land. There is also more likelihood of getting a good stand by surface planting than by listing. The returns from surface planting and listing average practically the same in a series of years. Spring cultivation before planting with a lister has resulted in small increases in yields. There have been no significant differences between the results of fall and spring plowing. Sub-soiling has been tried each year, but has not increased the crop yield. Summer tilling has increased the crop yields, but hardly enough to justify the general use of the practice. It is very difficult to prevent soil blowing during the winter on ground that has been bare summer tilled.

C. B. BROWN,
Supt. Tucumcari Dry-land Experiment Station.

CONCLUSIONS.

1. Sorghums require about the same culture as corn.

2. They are more drouth resistant than corn.

3. They should not be planted till all danger of frost is past and the soil is warm.

4. Yields of over 21 tons of silage per acre have been secured at the New Mexico Experiment Station from the Japanese variety of sorghum.

5. Sorghum both for forage and grain is a very dependable crop for the dry farmer.

6. It can be used as a second or catch crop by the farmers in the warmer irrigated valleys.

7. Silage made from sorghum has about the same feeding value as corn silage.

8. The sweet sorghum should be allowed to become fairly mature before cutting for silage.

BULLETIN NO. 120
December, 1919

New Mexico College of Agriculture and Mechanic Arts

Agricultural Experiment Station
State College, N. M.

This pile contains eighty-two bales of Durango cotton.
(Carlsbad district.)

Cotton Growing

BY RUPERT L. STEWART

Printed by The Rio Grande Republic, Las Cruces, N. M.

New Mexico Agricultural Experiment Station

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†Superintendent of the Tucumcari, N. M., Field Station, operated by the U. S. Department of Agriculture, in cooperation with the New Mexico Agricultural Experiment Station.

COTTON GROWING

HISTORY

The data presented in this bulletin represent the first steps in a comprehensive study of the cotton industry in New Mexico. The New Mexico Agricultural Experiment Station was the first to attempt to introduce this crop into the State in modern times. As early as 1891 the Station carried on some preliminary cotton experiments, as evidenced by the following copied from New Mexico Experiment Station Bulletin No. 6:—

"Cotton—(Gossypium herbaceum.) Five varieties, viz: Big Boll, Poor Man's, Upland, King's Prolific, and Sea Island, were planted April 14, in hard, black, alluvial soil. During the growing season the plants were thinned and cultivated twice and irrigated three times. The Sea Island made very large growth of stalk and many bolls, a few of which ripened. The staple was fine, long and very beautiful. The Upland ripened half its bolls, and the other two matured entire. The growth of stalk of the Poor Man's was short, not exceeding a foot and a half, and quite prolific. One noticeable feature of the stalk growth of cotton in this climate is stalkiness of stem near the ground. While the trial is only preliminary, the results are very satisfactory, and more extended experiments will be carried on the coming season.

"The following table gives the required data:—

NAME	Sq. Feet	No. Stl'ks	First Picking	Weight of Seed Cotton	Computed Yield per Acre	Length of Fibre
Big Boll	724	224	Sept. 1	28 1-2 pounds	1714 pounds	1 3-8 in.
Poor Man's	748	254	Sept. 1	26 1-2 pounds	1542 pounds	1 1-8 in.
Upland	872	138	Sept. 18	19 pounds	948 pounds	1 1-2 in.
King's Prolific	1284	427	Sept. 1	89 1-2 pounds	2934 pounds	1 1-4 in.
Sea Island	1056		Sept. 25			

"Much cotton ripened after frost and was not included in the above. The amount of lint cannot be given, owing to having no means of ginning."

Cotton has been successfully grown in this State for a number of years, but the area of production has been largely confined to the Carlsbad district in the Pecos Valley. A careful study of the weather data collected at this Station and the Carlsbad district showed that as far as climatic conditions were concerned, cotton could be grown with equal success in the Mesilla Valley. The question of cold nights, due in part to the rather high elevation, has oftentimes been looked upon as a limiting factor in producing this crop; but this theory has been to a large extent disproved by the results obtained at the Station and in the Mesilla Valley. The elevation in this locality is slightly greater than that of the Carlsbad district. There were so many conflicting opinions about the suitability of this locality for cotton that the New Mexico Experiment Station decided to give this crop a fair test. A little work with cotton was done prior to 1916, but during the winter of 1916 a very comprehensive project was outlined with a view of giving this question a thorough and impartial trial. Seed of a number of varieties,—twenty-eight in all—was collected and planted in the spring of that year. This was secured from many sources, but in most cases an attempt was made to get seed that was grown under climatic conditions as nearly like those prevailing at the Experiment Station as possible. The results of this preliminary trial were very encouraging; a number of varieties gave yields amounting to considerably over a bale of lint cotton to the acre. In 1917, the Durango variety was planted on the mesa land, which is some forty feet higher than the valley; the idea in this case being to determine whether or not cotton required a heavy soil in this locality. The results were again very favorable; and since that time cotton has been grown both on the mesa and valley soils with good success. No attempt will be made in this bulletin to give a very comprehensive treatise on cotton growing; but simply in as brief a manner as possible tabulate the results thus far obtained with this crop. The Experiment Station has also done some cooperative work with farmers in the Pecos Valley near Roswell (a letter on page 12, from Mr. Ben Ames of Roswell, gives some interesting data), and in Valencia County near Los Lunas.

COTTON GROWING IN 1916

In view of the fact that the cotton experiments have been somewhat varied each year, it is thought best to take up and discuss independently of each other the methods used and the results obtained each year.

In 1916, the land selected for the experiment was in young alfalfa. The soil was not very uniform in texture, but an attempt to overcome this was made by duplicating the plots. The soil might be classified as a clay loam, rather heavy in spots. The field was plowed in January, harrowed and leveled; and on April 11 the land was again harrowed and dragged preparatory to planting. Plantings were made on the 12th, 13th, 21st and 24th of April, and the 16th of June. A large per cent of the cotton seed that was planted on the 12th and 13th of April rotted and a very poor stand was the result. The plots that were planted on the 21st and 24th of April came up well and a good stand was secured, with the exception of a few varieties where very poor seed was planted. The plots that were planted on the 16th of June germinated well and a good stand was obtained; but the majority of the bolls did not mature before frost.

The cotton seed was planted with an ordinary one-row Avery cotton or corn planter, in rows forty inches apart, at the rate of about twenty pounds of seed to the acre. A bushel of cotton seed usually contains between 120,000 and 150,000 seeds, or enough, if each one developed into a mature plant, to suffice for fully fifteen acres. However, it is customary to plant quite heavily, especially on stiff land; and it is advantageous to have a thick stand of plants so that the combined strength of the plants may be exerted to break through the surface crust, which is often too strong to be broken by a single plantlet.

All but two plots were irrigated after planting; in other words, "irrigated up." These two plots were planted in a moist seed bed and allowed to germinate before irrigating. The plots that were irrigated up were harrowed with a spike-tooth harrow as soon as the ground was dry enough to allow a team to walk on it without sinking. Very little difference was noticed in the stands secured under the two methods of planting, but the cotton came more quickly on the plots that were irrigated after planting. All of the plots were irrigated six times and the water turned off after being allowed to stand an hour or so. The plots were cultivated four times during the season.

The following table gives the yields of the eight varieties giving the highest yields:

Burnett's 1.47	bales	per	acre
Durango 1.46	"	"	"
Allen's Improved Triumph...1.37	"	"	"
Lone Star....... ....0.93	"	"	"
Half-and-Half..............0.78	"	"	"
Rowden's Big Boll.........0.57	"	"	"
Mebane 0.41	"	"	"
U. S. D. A. No. 360........0.13	"	"	"

COTTON GROWING IN 1917

In 1917, two plots were selected on the mesa previously referred to, about forty feet higher than the valley. The soil is quite sandy, with pockets of gravel scattered here and there, mak-

Fig. 1.—A plant of Durango cotton after first picking of 40 bolls.

ing it quite porous. The plots had been fallowed for two years previously and had not been watered nor cultivated. The plots were plowed to a depth of six inches on May 22, and were harrowed with a spike-tooth harrow. The cotton was planted on

May 28 in rows forty inches apart. The plots were thinned to about twenty inches in the rows on July 10. The first blooms were noticed on July 26, when the plants were about eighteen inches high. The first picking was made October 1. Early frost caught many of the late blooms.

The Durango variety was used. The cotton germinated very quickly and a good stand was secured, but owing to the lateness in planting, a large number of the bolls did not have time to mature before frost and the yield was thus cut down, but in spite of this fact .82 of a bale of lint cotton per acre was secured.

COTTON GROWING IN 1918

The field of valley land that was selected for this year's experiment had previously been in hog and dairy cow pastures, being seeded each year to an annual pasture crop. The soil was somewhat ununiform, but probably not more so than the average field in this section of the State, and is classified as Gila Clay by the Bureau of Soils.

There were 1.3 acres of cotton planted, and it yielded at the rate of 1.35 bales of lint cotton per acre, figuring 1,500 pounds of seed cotton to a 500-pound bale of lint cotton. The seed was planted with a one-row Avery cotton or corn planter, in rows about 42 inches apart, at the rate of 15 pounds per acre. It was planted in moist soil, but to insure better germination the plots were given a light irrigation. The crop was chopped and thinned to 12 inches in the row when the plants were about 4 inches high. This cotton was given two cultivations with a cotton or corn cultivator, and was hoed five times, including the chopping; extra hoeing being necessary on account of the weediness of the ground.

The cotton was planted on April 22, and the first blooms were noticed on July 5. The first picking was made September 28, the second picking on October 18, and the third and last picking on November 19.

Different types of fertilizers and different methods of planting were compared, in order to get some idea of the best methods to follow in growing the crop in this valley. Some of the cotton was planted on the ridge, some in the list and some on the flat. The best stands were apparently secured when the cotton was planted on a small ridge, but this would probably not be practical when the cotton is grown on a large scale, as it takes too much time to prepare the land. When it is planted on a ridge, however, water can be used to force germination, which is sometimes a good idea, in view of the fact that the heavy winds in the spring

sap the soil of much of its moisture, thus rendering it difficult to germinate seed. If ridges are used they should be small and the tops knocked off with a plank, or leveler of some kind, and the dirt thrown to the cotton plant at each cultivation.

The cotton that was planted on the flat and "irrigated up" was harrowed lightly just as soon after irrigation as it was possible to get a team on to the ground without puddling the soil.

The fertilizers that were used this year were barnyard manure, sulphur, acid phosphate, lime, and cottonseed meal. The manure was applied at the rate of about 5 tons per acre; sulphur and lime at 200 pounds per acre; and acid phosphate and cottonseed meal at 300 pounds per acre. About one-tenth of an acre of cotton was used for each plot, and the following table gives the yield of each picking, the total yield, and the yield per acre:—

TABLE I.—COTTON GROWN IN 1918

Plot No.	Sept. 28 1st Picking	Oct. 18 2nd Picking	Nov. 19 3rd Picking	Total	Yield perAcre Seed Cotton	Yield perAcre Lint	Treatment
	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	
1	53	82	117	252	1968	652	Manure
2	29	70	89	188	1492	497	Sulphur
3	20	76	116	212	1652	550	Lime
4	39	93	155	287	2242	747	Acid phosphate
5	34	86	186	306	2335	778	Cottons'd meal
6	32	89	190	311	2221	740	No treatment

As will be noted from the table, no apparent advantage was secured from fertilizing, but as these are the figures for only one season they should not be taken as conclusive.

Several plots of cotton were planted on the mesa soil this season. The best plot gave a yield of 1.9 bales per acre, and the entire field yielded at the rate of 1.25 bales per acre. The cotton was planted on April 23 and was picked three times: twice before frost, and once afterward. The bollies were not picked, which would, of course, have increased the yield somewhat.

COTTON GROWING IN 1919

The work that was done with this crop in 1918 was repeated in 1919. The cotton was again planted on the same piece of ground and was given the same kind of treatment. The cotton was planted on April 23, chopped on June 4 and was given two other hoeings, one the last of June and one in July. It received two cultivations, one in June and one in July; and was irrigated five times, including the light irrigation which was given to induce

germination. The entire field yielded at the rate of 1.25 bales per acre.

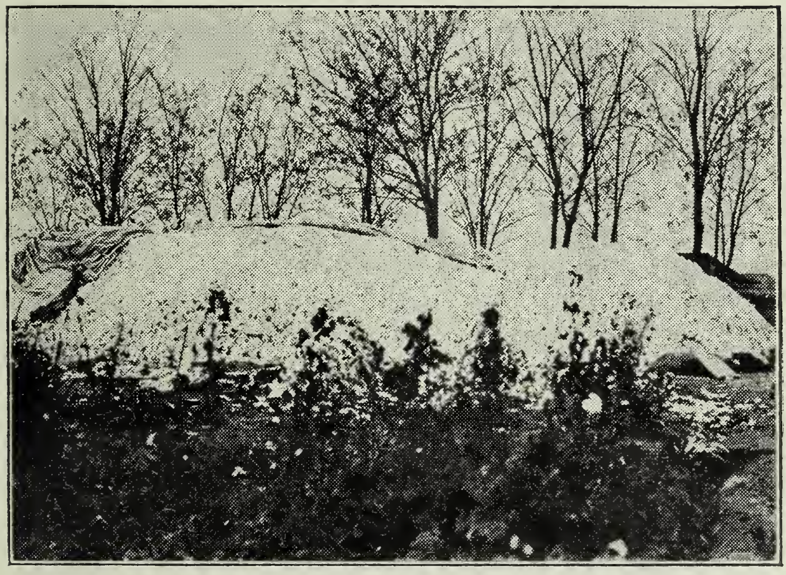

Fig. 2—A pile of cotton grown in 1919 at Telles, Dona Ana County.

The following table gives the data on the cotton which received different treatments:—

TABLE II.—COTTON GROWN IN 1919

Plot No.	Sept. 7 1st Picking	Oct. 3 2nd Picking	Dec. 1 3rd Picking	Total	Yield perAcre Seed Cotton	Yield perAcre Lint	Treatment
	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	
1	145	60	14	219	1625	541	Manure
2	134	60	17	211	1525	508	Sulphur
3	135	68	21	224	1673	558	Lime
4	142	102	23	267	1977	659	Acid phosphate
5	151	128	27	306	2285	762	Cottons'd meal
6	171	135	22	328	2450	813	No treatment

The results obtained, both in 1918 and 1919, do not indicate that fertilizing increases the yield very much; however, there are not as yet sufficient data on which to base conclusions on this point.

In addition to the cotton grown in this experiment, eight plots of the same variety were planted on the mesa land. The yield for the entire area was .7 of a bale to the acre.

COTTON ON WATER-LOGGED LAND

In order to determine whether or not this crop could be grown successfully on land which is heavily impregnated with alkali, and where the water table is within a short distance of the surface, a small piece of land was cleared in the old river bed on the College Farm. This land was plowed the first of May, and the cotton was planted the 5th of May; after which it received no further attention. It was not irrigated, neither was it hoed or cultivated. The seed did not germinate as well as it would have, had it received a light irrigation, but the cotton that germinated grew well and produced plants of good size, bloomed, and produced a fairly good yield. This cotton was picked the latter part of October, and at that time measurement was taken to determine the water table, which was found to be within 24 inches of the surface. The land at this time was covered with a thick crust of white alkali, as is indicated by figure 3.

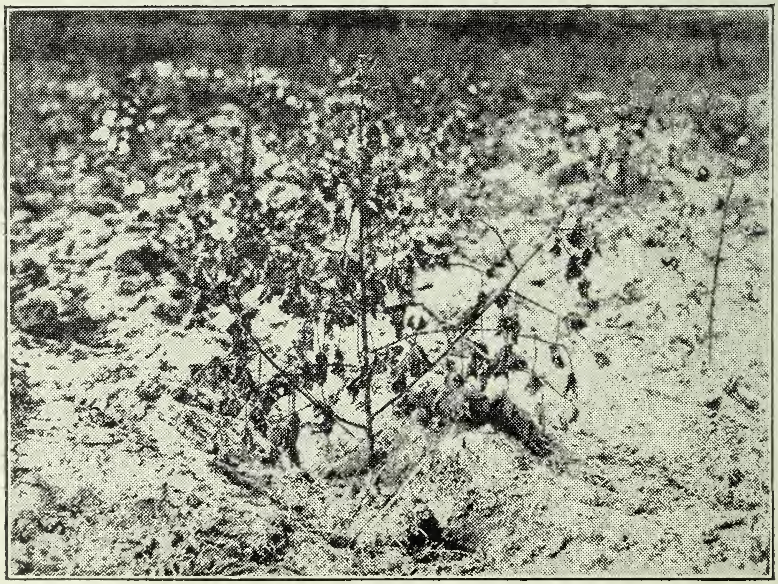

Fig. 3.—Cotton growing on alkali land.

The results of this trial would indicate that cotton will stand a considerable amount of alkali and will grow when the water table is within a short distance of the surface of the ground. However, the conclusion should not be drawn from this experiment that it does best on this kind of soil, because as with any

other crop, best yields are secured on a good soil that is properly drained and free from troublesome weeds.

VARIETIES

Cotton is a cross-fertilized plant and, therefore, mixes quite readily when two or more varieties are planted in close proximity to each other; and, in fact, it is likely to cross even when the varieties are planted some distance apart, as the pollen is carried by the wind and by bees and other insects. In the beginning of the cotton industry in a new section it is, therefore, particularly important that considerable precaution be taken in selecting the varieties. It is quite obvious that a large number of varieties should not be grown in one section, as cotton with a uniform staple cannot be secured in this way. The necessity of standardization is just as important, if not more so, with cotton as with any other crop. The history of the industry in Arizona bears out the above statement. When cotton was first introduced into that State, the farmers were advised against planting short staple varieties, but these men were largely from Texas and other cotton growing states, and had been accustomed to the production of the short staple and, therefore, did not heed the advice of the Experiment Station and the U. S. Department of Agriculture and planted a large acreage of short staple cotton. They grew two crops, but getting neither the yield nor the price they had expected, they began to grow long staple cotton. In doing this they, of course, experienced considerable difficulty in getting all the short staple varieties out of the country, to prevent mixing; and the gins also had to be remodeled to take care of the long staple cotton; both of which were expensive. The same condition prevailed to some extent in the Carlsbad district of New Mexico. Both short staple and Durango cotton have been tested out for a number of years, with the result that now by far the largest per cent of all cotton produced in that district is Durango; and many forces are being brought to bear to eliminate the growing of any other variety. The past season Durango cotton has brought from 20 to 25 cents a pound more than the short staple varieties, and this, coupled with the fact that it yields well in the irrigated valleys of southern New Mexico, accounts for the increased acreage that is being planted to this variety.

Mr. D. A. Saunders, formerly with the U S. Department of Agriculture and now Manager of the Saunders Lone Star Seed and Gin Co. of Greenville, Texas, has the following to say about a sample of Durango cotton which was sent him from the New

Mexico Agricultural Experiment Station:—"The sample of Durango is fully as good as any I have ever seen from any long staple section. The fibre is full 1 3-16 inch in length and good and straight. Cotton of this length is worth something like 10 cents per pound premium." This was at the beginning of the ginning season; now the Durango cotton is bringing a premium of from 20 to 25 cents per pound.

The following is an extract from a letter recently received from Mr. Ben Ames of Roswell:—

Roswell, N. M., December 30, 1919.

The seed was planted May 16, and test was chiefly to determine maturity before frost. Plants were well cultivated, and received water as needed.

While personally unacquainted with cotton culture, I called in several men who had raised cotton extensively, and their estimate of yield varied from 1 bale to 1½ bales per acre. Frost held up till about November 1. Some bolls were still immature, but enough had opened to indicate yield as above stated. Planting might have been done two weeks earlier.

I am of the opinion that in average years cotton can be successfully raised here. The unfavorable feature is the coolness of the nights in the early growing season. While frost was rather late this year, had it been two weeks earlier there would have been enough cotton to make it profitable.

Yours truly,

Ben Ames.

The following article gives in a brief way the general practices that are being followed in the growing of cotton in the Carlsbad district of the Pecos Valley:—

COTTON GROWING IN EDDY COUNTY

To many citizens of the State of New Mexico, it may seem strange to say that New Mexico has been producing cotton for a good many years. But however strange it may seem, it is, nevertheless, a fact.

Cotton has been grown with more or less degree of success in different parts of the State, but to Eddy County, and more especially to the Carlsbad Reclamation Project, belongs the distinction of being the one center in the State where the crop has been made a commercial success. As an evidence of the success of the crop on the Project this past year, close to one and one-half millions of dollars will be added to the Project farmers' pockets.

The season of 1919, while in all probability the most successful year yet experienced by Project farmers, is not the first year that cotton has been grown. The crop has been tried with more or less irregularity for the past eighteen to twenty years, and for the past ten years it has been looked upon as one of the chief crops. In these years farmers have learned how to handle the crop, what its needs are, so that today cotton growing is not a new or untried adventure, but a practical, sure-paying proposition for these farmers, and cotton is looked upon as the leading crop.

The old saying that "Preparation is one-half the crop" will, if it holds true with other crops such as wheat, corn, oats, alfalfa, etc., hold doubly true in the case of cotton. Due to the peculiarity of the cotton plant, in that it is very susceptible to adverse conditions when young, much extra care and attention must be given the preparation of the seed bed if the crop is to be a success.

Deep fall or winter plowing should be practiced, letting the ground lie until spring. Then a good cultivation, preferably with a disk harrow, should be given; this cultivation to be given as early in the spring as possible, because it will not only conserve moisture that has fallen during the winter, but will tend to warm the ground. Weeds, etc., will be started also, and a later cultivation will kill them, thus making the ground cleaner and freer, cutting down the expense of fighting weeds.

Just before the time for planting the ground should be thoroughly irrigated, and as much water as possible put in the soil. As soon as the ground will permit, a shallow cultivation should follow, which will break up the forming crust, form a mulch for conserving moisture, and will leave the seed bed in first-class condition. This cultivation may be done, also, with a disk harrow, and should not be deeper than is necessary to secure a good job of cultivation.

Another method, which is a little different from the one above, one which is sometimes followed, and which will produce very good results,is to middle-bust or list the field just before the irrigation, then allow the water to follow down the furrows. Planting in this case may be done in either of two ways, but in any case it is usually done just as soon as the ground will permit. Planting may be done in the lists, as soon as the ground has dried enough to permit it. The second way is to wait until the surface of the ground has dried sufficiently to allow cultivation with a drag harrow; then the field is harrowed crosswise with the lists, and planting is done on top of the ridges. In any case, regardless of the method used in preparing the soil, it is the all important thing to see to it that there is no crust over the seed, that the seed are in moist soil, and that they are not too deeply buried.

In case of planting on the level, that is, having the ground prepared

as cited above in the first case, sometimes a sweep or auxiliary shoe is added in front of the planting shoe of the planter, and set so that all the dry soil is pushed out of the way, thus allowing the seed to be placed in moist soil, and at the same time not burying them too deep.

Planting may be done any time after the ground has warmed sufficiently and all danger of a killing frost is past. The exact time will vary greatly. In a general way it may be said that planting on the Carlsbad Project is done between April 10 and May 10, with the bulk of it about the middle to the 20th of April. The planting is done in rows, which are from 42 to 48 inches apart. About 20 pounds of seed should be used per acre. This is sufficient to insure a good stand. The seed should be put in with a regular cotton planter, of which there are many good types in use. There is one thing to be careful of, and that is not to use a planter with a press wheel which will tend to pack or crust the ground over the seed, as this light crust will be sufficient to prevent many plants from coming through, and a poor stand will result.

Fig. 4—A field of Durango cotton in the Carlsbad district, Eddy County, New Mexico.

No water should be applied until the plants have reached a height of some two inches or more, and then not unless the plants are suffering. If it becomes necessary to irrigate at that time, it should be a light irrigation. Later a good irrigation can be given. The number of waterings varies greatly, and depends upon the season, the soil, etc., but Project farmers find about two irrigations after planting to be sufficient.

Immediately after each irrigation, and just as soon as the ground will permit, cultivation should begin. Project farmers find that it "pays to cultivate," and from two to four cultivations are given the

ground for each irrigation. Cultivation should be shallow, just enough to stir the surface and kill any weeds that might be showing. The work can be done with the ordinary one or two row cultivator.

When the plants get about 8 to 10 inches high, it is necessary to "chop" or thin them to a stand. A good stand is considered to be one or two plants every 12 to 18 inches in the row, and the idea in chopping is to get as near this stand as possible.

The matter of varieties is a question which has caused a great deal of discussion. The Project farmers have found that Durango is returning them a very good income, and this past season, roughly 75 per cent of the total acreage was of that variety. This cotton brings a good premium on the market, the staple runs from one and one-eighth to one and one-quarter inches, produces a good yield per acre of seed cotton, and the seed cotton will produce better than one-third of lint cotton. Webb is a new variety, in so far as the Project is concerned, and it seems to be gaining in favor. In staple it is about the same as the Durango, and in fact, this past season it marketed the same as Durango. It appears to have a shorter growing period, of from 3 to 8 days, than the Durango. In production it seems to be about the same. Lone Star has been tried this year, but did not prove itself to have any special advantages over Durango. It did not bring the same premium as Durango, but it was found to have a shorter growing period. It, however, brought a few cents premium over the short staple cotton. Mebane has been grown very extensively in the past, but it is gradually losing ground. It is a short staple cotton, has a shorter growing period, produces more lint cotton to the given amount of seed cotton than Durango, but does not command any premium on the market. This past season, as high as twenty cents premium was paid for the long staple cotton over the short staple. Big Boll Rowden, Acala, and Heavy Fruiter, are some of the other varieties that have been and are still being grown, but none seems to possess enough advantages to be a better cotton for the Project's conditions than the Durango.

The average returns from all cotton fields in the county for the past season amounted to approximately $165.00 an acre. To produce the acre, it cost roughly $70.00 to $75.00.

It is, therefore, because cotton can be successfully grown, and that it will return a good income from an acre, that cotton has found its way to the head of the list of field crops on the Carlsbad Reclamation Project.

Arnold Z. Smith,

County Agricultural Agent.

TABLE III.—LENGTH OF GROWING SEASON

Year	Date of last killing frost in spring	Date of first killing frost in fall	Length of growing season
			Days
1908	March 23	Oct. 20	211
1909	April 7	Oct. 10	181
1910	Feb. 28	Oct. 22	236
1911	March 12	" 22	225
1912	May 4	" 29	178
1913	April 22	" 27	189
1914	March 23	Nov. 14	236
1915	May 3	" 8	189
1916	April 5	" 8	217
1917	April 6	Oct. 19	196
1918	March 23	" 29	218
1919	March 20	Nov. 2	226
	Average		208

The above table gives the length of growing season for the past eleven years at the New Mexico Agricultural Experiment Station. The past four years the Durango variety of cotton has been successfully matured at the Station, which would indicate that the growing season in the Mesilla Valley is plenty long for this variety. The temperature readings were made on the mesa about forty feet higher than the valley.

SUMMARY

1. Cotton was grown at the New Mexico Agricultural Experiment Station as early as 1891.

2. This crop can be grown successfully on both mesa and valley soils.

3. Cotton has been matured successfully the past four years at the Experiment Station.

4. The Durango variety produces good yields and lint of excellent quality.

5. The cotton grown last season had a staple of 1 1-4 inches, according to the United States Department of Agriculture.

6. The experiments indicate that the best results are secured when the planting is done the latter part of April.

7. The climate and soil of the Pecos Valley and Mesilla Valley are very similar.

8. The Durango variety of cotton has made an average yield of 1.35 bales per acre in the three years it has been grown at the New Mexico Agricultural Experiment Station.

B

BULLETIN NO. 121
(TECHNICAL)

December, 1919

New Mexico College of Agriculture and Mechanic Arts

Agricultural Experiment Station
State College, N. M.

FIG. 1.—A FIELD OF CHILE PEPPER, SHOWING INFECTED AREAS WHERE THE PLANTS HAVE BEEN KILLED BY FUSARIUM ANNUUM.

FUSARIUM WILT OF CHILE PEPPER

BY LEON H. LEONIAN

Printed by The Rio Grande Republic, Las Cruces, N. M.

New Mexico Agricultural Experiment Station

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*In cooperation with the Office of Public Roads and Rural Engineering, U. S. Department of Agriculture.

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Fusarium Wilt of Chile Pepper

A wilt of chile pepper was observed for the first time on the farm of the New Mexico Experiment Station in 1908. Three years later when general attention was called to this disease, it was so prevalent all along the Rio Grande Valley "as seriously to impair the output of chile pepper for the year." The farmers who had been growing the crop became very desirous of finding a remedy for the trouble; turning naturally to the Experiment Station for assistance. H. S. Hammond, then botanist for the Station, started the investigation of this disease as an Adams project and continued it for three years. After him Mann, Werkenthin, and finally the writer successively took charge of the problem. While this paper gives the results of the investigations extending from 1911 to 1919, the work done during 1918-19 forms its principal part.

THE HOST

The word *chile* is the Spanish name used for red peppers (Capsicum annuum). This name, however, has been generally used to distinguish the "hot" type of red peppers from such mild varieties as Bull-nose, Chinese Giant, Ruby King, etc.

The chile pepper is used extensively as an article of diet by the Spanish speaking population of the Southwestern part of the United States and in Mexico, and its use is gradually becoming more general among the Anglo-Americans. It is eaten both in the green and in the ripe state. Green peppers are canned in large quantities, while the ripe pods are dried and stored for future use.

Chile pepper is a good producer. As high as 20,290* pounds of green pods per acre have been produced on the Station farm. Twenty dollars a ton is an average market price for this product. The College variety No. 9 has yielded as much as 2,676† pounds of dry chile to the acre. Dry peppers seldom sell for less than ten cents a pound. This means large profits, and the farmers have been quick to realize it. Ever since the appearance of the chile blight, however, the growing of this crop has been regarded a venturesome occupation.

*N. M. Sta. Bul. No. 67, P. 26.
†N. M. Press Bul. No. 289.

THE DISEASE

The Name.—This disease is known by the name of "chile blight," "wilt," and "black leg of chile." The name "chile blight" is most commonly used. *Fusarium wilt of chile pepper,* however, is proposed as a more appropriate name.

Origin and distribution.—New Mexico seems to be the only state, according to records, where this disease is present and serious enough to cause trouble. A circular letter was sent to every Experiment Station in the southern, southwestern, and western states where peppers grow successfully, asking information about the diseases of peppers, especially about wilts. Prof. Smith reported that a wilt is quite a common occurrence on winter grown peppers in California, and although he had isolated a Fusarium species from the infected material, he had not attempted to reproduce the fungus from artificial inoculations. Prof. Ness, Horticulturist of the Texas Station, has noticed occasionally, some sort of blight on chile peppers; Dr. Taubenhaus thinks this blight is probably due to Sclerotium rolfsii, since this fungus is very prevalent in Texas, where it causes a serious blight of tomatoes. Prof. J. L. Hewitt stated that his attention had been called to a disease of ordinary sweet peppers in Arkansas. He believed, however, that the trouble was of bacterial origin, although he did not attempt to determine the real nature of the causal organism.

Previous work.—H. S. Hammond was the first investigator to take up the problem of "chile blight," in 1911. He believed that Bacterium solanacearum was the causal organism and that the trouble was confined to parts of plants above the ground. During the year 1914-15 the investigation was continued by J. M. Mann, who came to the conclusion that the disease was not of bacterial origin, but that it was due to some fungus. He did not, however, prove this definitely, nor did he attempt to identify the fungus. It remained for F. C. Werkenthin to isolate the causal organism, a Fusarium species. Some of his inoculations, both in the greenhouse and in the field, gave positive results. He grew seedlings under sterile conditions, and when he inoculated them with this Fusarium species, the greater majority of the seedlings wilted and died. He did not, however, finish the identification of the fungus, nor did he work out its physiology. The writer took charge of the investigations in the fall of 1918.

Economic importance.—Previous to 1908 this disease was unknown. That year Garcia (1) stated that "There were no diseases troubling the chile." In 1911 there was an outbreak of the disease, and at present most of the chile growing sections of the

State have more or less of it The severity of the infection varies in different localities and causes a loss of ten to ninety per cent of the entire crop. This disease is the chief factor which limits a profitable production of chile peppers. Nematodes and an Alternaria fruit rot and stem blight are of secondary importance.

Symptoms.—A rapid wilting of the leaves and drooping of the younger shoots, followed by a general browning and drying of the foliage, constitute the characteristic signs of the disease. Wilting first affects the lower leaves, which curl perpendicularly to their middle vein and droop; later the upper leaves are similarly affected This process generally takes place in a very short time. In one instance the writer observed a plant which appeared normal at 9 a. m., but was completely wilted two hours later. The stems, on account of their woody nature, remain erect after the drooping and the consequent falling off of the the majority of the leaves; but the young shoots, and the tender, growing parts droop and soon dry.

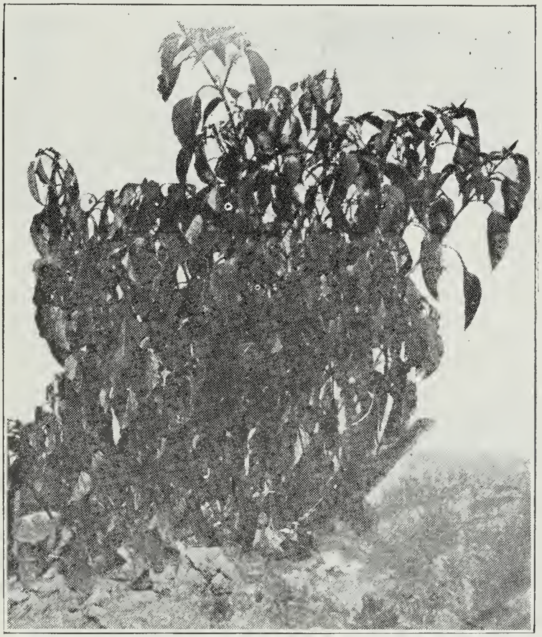

FIG. 2.—A CHILE PEPPER PLANT JUST BEGINNING TO WILT.

The roots, the underground stem, and often the lower part of the stem above the ground may be invaded by the pathogen. Dark brown and sunken lesions may appear on the base of the aerial stem of the affected plants, and by a gradual circling movement they girdle the stem. The bark becomes dry and brown, and the wood beneath is darkened. This darkening may be confined to the outermost layers alone, or it may involve all the tissues, the pith included.

When a newly wilted plant is dug and examined, a part of, or

more commonly the whole underground stem, as well as a portion of the roots, will appear browned or blackened. The affected bark

FIG. 3.—HEALTHY PLANT ON THE LEFT; WILTED ON THE RIGHT.

of the underground stem, especially in wet soils, is reduced to a dark mass of broken down tissues which easily rub off between the fingers, exposing a smoke-colored wood. When a wilted plant is

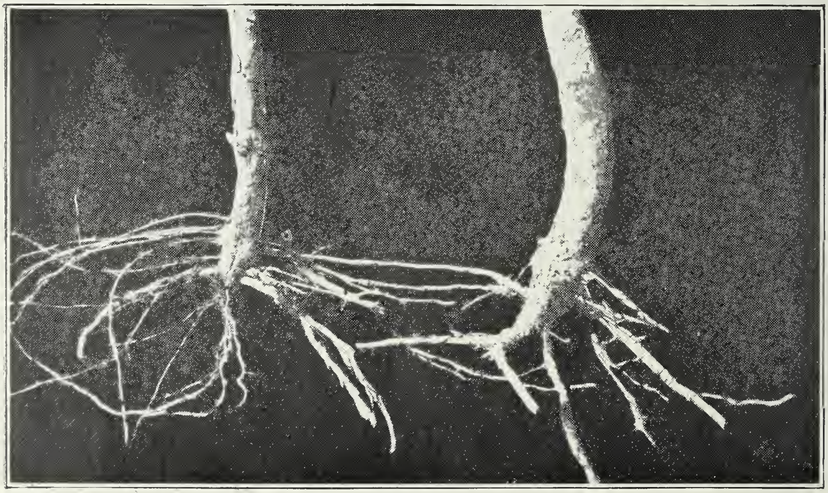

FIG. 4.—THE LOWER PARTS OF THE TWO DISEASED PLANTS, SHOWING THE INFECTED UNDERGROUND STEM FROM WHICH THE BARK IS PEELING OFF.

pulled out of the ground the cork cambium peels off from the badly infected roots and remains in the soil. The diseased roots are dark brown, at first brittle, then soft and water soaked; whereas the healthy roots are creamy in color, and strong and rigid in structure. The infection may be confined to a few roots alone, or it may alternate with the healthy parts on the same root. Often, immediately after the wilting of the plant, most of the roots may be found unaffected, while the base or any of the regions of the underground stem may be browned or blackened as the result of the activities of the fungus. Less frequently the majority of the roots may be diseased, while only the basal portion or the stool of the underground stem may be affected. This is generally the case when the young plants are not set too deep and the roots are nearer the surface layers of the soil where the fungus seems to thrive best. The underground stem of diseased plants, especially in wet soils, may become covered with white or bluish-green sporodochia of the fungus four or five days after the wilting of the plants. No sporodochia have been observed on the stems above the ground.

Effect.—The general effect of the disease upon the crop is quite striking. Groups of wilting or dead plants, some with a few of their shriveled, dry, brown leaves still clinging to them, are very conspicuous in a field of green plants. The infected areas form various sized patches which gradually enlarge as the season progresses. If the plants are attacked early in the season, no fruit is formed and the plant is a total loss to the grower. If the disease does not manifest itself until late summer, the pods can be harvested and sold as green chile pepper. If left on the vines, they soon shrivel and fall off. In case the plants are not diseased until late in the season, the green pods will mature after the death of the plant, but will lack the fleshiness of the pods matured on healthy plants.

ETIOLOGY

The writer's predecessor, F. C. Werkenthin, repeatedly isolated a Fusarium species from wilted peppers. A very large number of isolations made by the writer yielded the same organism. This fungus belongs to the section Martiella. and exhibits physiological and morphological characteristics not like those possessed by the other species of the section Martiella. The writer realizes the fact that many of the species of Fusaria in a given section have a very close and often confusing resemblance, and that some of their morphological properties are subject to rapid fluctuations, but since the other species of the section Martiella were found unable to

attack chile peppers even under the most favorable conditions, and since none of them yielded cultural and morphological characteristics identical with those of the chile wilt organism, the writer felt justified in classifying it as a new species. *F. annuum* is the name proposed for this fungus.

The following tables give the average sizes and the percentages of the spores of F. annuum as compared with the sizes and percentages of the spores of the other species in the section Martiella. The figures for F. eumartii are given by Carpenter (2), those for F. martii, F. solani, F. striatum, F. radicicola, and F. coeroleum have been taken from Sherbakoff's (3) Fusaria of potatoes.

Table 1.—A comparison of the sizes of spores of F. annuum and those of the other species of the section Martiella.

	0-septate	1-sept.	2-sept.	3-sept.	4-sept.	5-sept.	6, 7, 8-septate
	Microns	Microns	Microns	Microns	Microns	Microns	Microns
F. annuum	11 2x4.4	17x5.5	25.2x5.2	39.2x6.1	46.3x6.5	50x6.5	Very rare,46x6.5
F. martii	11x4	20x4.5	V'y rare	43.9x5.1	49.3x5.3	54.3x5.5	
F. solani	8.7x4	17x4.3	22.5x4.6	29.7x5.5	35.5x5.8	44.3x5.8	
F. striatum	10x3.4	20x3.9	24.5x4.2	34.7x4.6	43.7x4.7	50x4.8	
F. radicicola	8x3	15x4		34.2x4.7	43.9x5.1	43.9x5.1	
F. eumartii					54.4x5.6	63.7x5.8	69.7x6.3, 71.6x6.5

Table II.—A comparison of the Percentages of Spores of F. annuum and those of the other species of the section Martiella.

	0-sept.	1-sept.	2-sept.	3-sept.	4-sept.	5-sept.	6-,	7-,	8-sept.
	%	%	%	%	%	%	%	%	%
F. annuum	25.3	20.2	3	30.1	10.3	12.1		Very	rare
F. martii	Rare	1	Very rare	53	43	3			
F. solani	5	11	6	76.5	1.5	Rare			
F. striatum	12	19.5	5.5	60	3	Very rare			
F. radicicola	56	16	3	23	2	Very rare			
F. coeroleum	4	6	5	78	4.5	2			
F. eumartii				7	20	50	8	15	

Steamed pepper stems, potato hard agar containing ten per cent glucose, and potato cylinders were the chief media used in culture work. Spores from these cultures, as well as from the sporodochia developed upon the underground stems of the plants which wilted in the field, were used in determining the sizes and the percentages of the different septate spores of F. annuum. It was found that 0-septate conidia predominated in the mycelium, often representing 95 per cent of all the spores. 3-septate, and often 4- and 5-septate spores on the other hand, especially under field conditions, formed the greatest majority of conidia in the sporodochia.

The most important physiological difference between F. annuum and the other species of the section Martiella is that the other species are not capable of attacking chile peppers. This was proved by a number of inoculations under controlled and sterile conditions. While the color reactions of F. annuum and those of the other species are quite different from one another, they cannot be considered

constant or reliable characteristics, as the slightest change in the medium brings about a rapid fluctuation.

F. annuum n. sp.—Microconidia are always present in large numbers, and are the first spores to appear in cultures. Macroconidia are mostly 3-septate, although 4- and 5-septate spores may, occasionally, be in the majority, especially under field conditions. Chlamydospores are mostly 0-septate and measure from 7 to 10.5 microns. They develop abundantly in the old cultures and may be both terminal and intercalary, borne singly, or in chains and clusters. Sclerotia form in large numbers, especially on whole, steamed potato tubers. They are generally flesh colored, darkening with age. The color reactions of this fungus vary according to the media; on potato plug they are bluish-green with the sporodochia showing a flesh or greenish tinge. A purplish brown color develops in steamed rice cultures, while on potato agar rich in glucose a salmon-colored reaction is followed by a dark purple.

Pathogenicity.—The fungus has been repeatedly isolated both from the roots and the stem lesions of wilted chile peppers. It develops very readily in cultures within three or four days. The constant association of the fungus and the host was demonstrated in hundreds of isolations made both by Werkenthin and the writer. Isolations were made by the writer throughout the year 1918-19. Badly decayed or newly attacked rootlets, roots, underground stems and infected aerial stems were used in all stages of development. Cultures were also made from the sporodochia formed on the underground stems. All of these isolations yielded the same organism.

The inoculation experiments were carried on both in the laboratory and in the field. Pot and water cultures were prepared and the plants were inoculated throughout the year. One-week-old seedlings, as well as young, and fully developed plants were used.

Chile pepper seeds were soaked over night in distilled water, then washed in 1-1,000 mercuric chloride solution for ten minutes, rinsed with distilled sterile water, and planted in Petri dishes containing a weak nutrient media (ammonium nitrate 1 g., dihydrogen potassium phosphate 0.5 g., magnesium sulphate 0.25 g., iron chloride, trace, cane sugar 5 g. agar agar 10 g., water 1,000 c. c.) As soon as the seeds germinated, the nutrient media in the dishes was inoculated with F. annuum. The growth of the fungus, which was quite sparse, was followed as it advanced towards the seedlings. The infection took place most readily at the tip of the primary root, which browned one day after coming into contact with the hyphae

of the fungus. Gradually this discoloration advanced, involving the secondary roots, the hypocotyl, and the primary leaves.

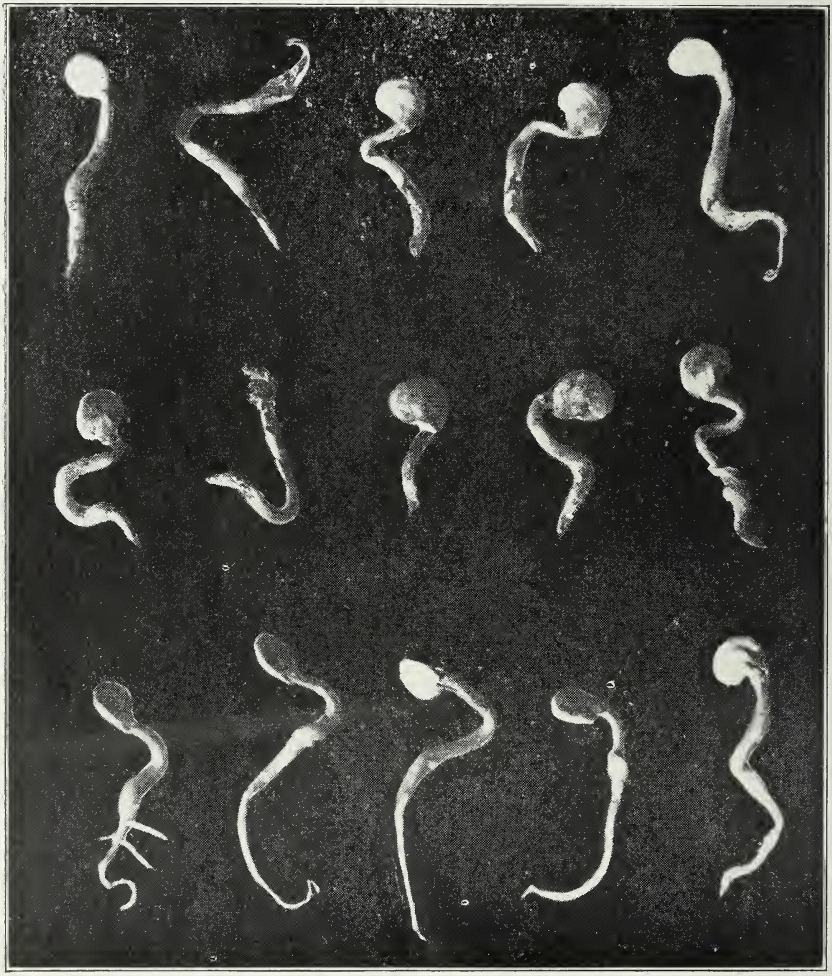

FIG. 5.—CHILE PEPPER SEEDLINGS. UPPER TWO ROWS INOCULATED, LOWER ROW CHECK.

The seedlings died 8 to 10 days after inoculation, at a temperature of about 27°C. The fungus was re-isolated from the hypocotyl lesions of the seedlings. All checks remained unaffected.

Seeds were planted in both autoclaved and untreated garden soils. As soon as the seedlings appeared, the soil was inoculated

with F. annuum by applying spore dilutions to each sample. The soil was kept constantly wet and at a temperature of about 27° C. After ten days most of the inoculated seedlings died, and a few days later the remaining seedlings wilted. All checks remained unaffected.

The soil used for larger plants was a rich sandy loam, sterilized in the autoclave.

Pfeffer's formula, as given below, was used for making water cultures:-

Calcium nitrate	4 g.
Potassium nitrate	1 g.
Magnesium sulphate	1 g.
Potassium acid phosphate	1 g.
Ferric chloride solution	trace
Distilled water	7 litres

The nutrient solution was placed in wide-mouthed, cotton-stoppered beakers of 500 c. c. capacity and sterilized. For the larger sized plants, beakers of 1,200 c. c. capacity were used. The chile pepper plants were carefully dug out of the soil, thoroughly washed (rejecting those which showed any trace of browning on their roots), kept in distilled water overnight, then placed in a 1-1,000 solution of mercuric chloride for five minutes, again washed with distilled, sterile water, and were planted in the pots, or transferred to the beakers containing the nutrient solution. The total number of these cultures was about one hundred. Every third pot or beaker was used as a check, and the rest were inoculated with F. annuum. Cultures of the fungus were thoroughly mixed with sterile water, and an equal amount of this mixture was applied to each pot or beaker. The temperature of the room varied from 25° to 30° C. Two weeks after the inoculation ninety per cent of the plants growing in the water cultures wilted and showed the characteristic lesions of Fusarium wilt. Sporodochia developed upon the stem above the surface of the solution four days after the wilting of the plants. F. annuum was re-isolated from the wilted plants. All checks remained unaffected.

Those of the potted plants which were kept at a temperature of 25° to 30° C. wilted from four to six weeks after the inoculation. The rest of the plants, which were kept at a temperature considerably below 25° C. (10° to 15° C.), did not wilt until the return of summer months. Eighty per cent of the pot inoculations gave positive results.

The first field inoculations were made on the 15th of May, 1919. The plants were then about eight inches high. Cultures of

F. annuum were washed and mixed with water; the dirt was removed from the base of the plants, and about 300 c. c. of the water containing the fungus spores and hyphae was applied to the soil; then the dirt was replaced. Inoculations were made successively during June, July and August. Two hundred plants were inoculated. All these plants were growing on the high and drier part of the field. No wilted plants were observed in this field until the first of August. Ninety-five per cent of the inoculated plants failed to show any infection This at first seemed very puzzling. A few days later it was noticed that the wilt was very prevalent in the lower part of the same plot and that about twenty-five per cent of the plants were affected. None of the plants in this part

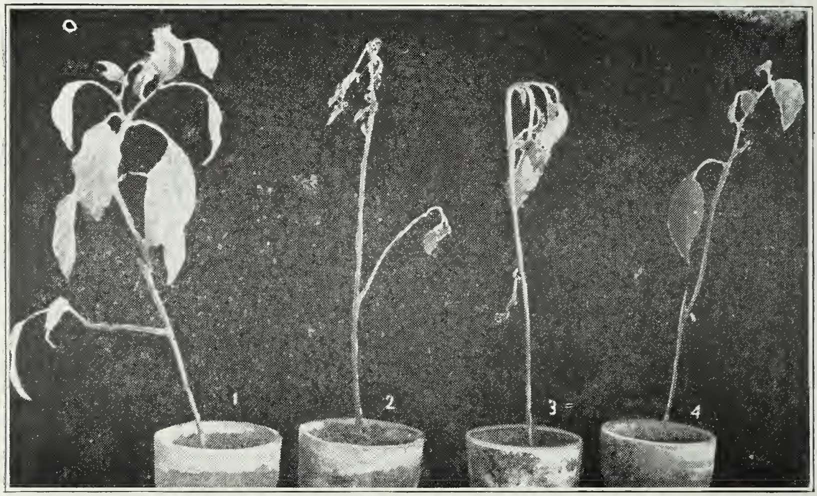

FIG. 6—No. 1, CHECK; NOS. 2, 3, AND 4, INOCULATED.

of the field were inoculated and the land was occupied, prior tobeing planted to chile peppers, by old peach trees. The lower and wetter part of another plot, not more than twenty-five yards away, became infected still more heavily, and eighty-five per cent of the plants wilted, while the upper and drier part of the same field showed only two per cent infection. It was then believed that the lack of proper drainage and the very high moisture content characteristic of these low spots in the fields were closely related to the occurrence of the disease. A number of healthy plants were selected in the lower part of the plot which showed a twenty-five per cent infection,

and were inoculated with F. annuum. Sixty-five per cent of these plants wilted and died one month after the inoculation.

Some inoculation experiments were performed in the laboratory to see if the fungus was able to attack the parts of the plants above the ground. Spores were sprayed on both injured and uninjured leaves and stems of ten plants, which were then placed in a moist chamber and kept at a temperature of 30° C. With one exception, the plants gave negative results. In the case of this one plant the primary infection started from the stub of a broken branch and gradually worked its way into the main stem, and continued to spread until the stem was girdled and the plant died. After the upward movement of the infection in the stem ceased, a rapid downward movement took place. In a week's time the entire root system was affected.

Dissemination.—Soil is the primary source of inoculum, and anything that will carry the soil from one place to another will also be able to carry the fungus along. The responsible agents for the spread of this parasite are dust storms, irrigation waters and methods of irrigation, the direct growth of the fungus hyphae in the soil, the remains of diseased plants, and cold-frame infection of the seedlings.

*Dust storms**—Dust storms are common in New Mexicoduring the months of February, March and April. The wind at times attains a velocity of fifty miles or more an hour. The air becomes full of fine dust and sand which, lashed by strong winds, rush ahead rapidly and cover long distances before settling down. Most of the plowing and harrowing is done during these stormy months. The loose dirt and any pathogenic organisms which it might contain are blown from one place to another. Bacteria, spores, hyphae, clinging to dirt particles or to bits of organic matter, may be carried from one farm to another, many miles away. This perhaps explains why even a virgin land is often found to be infested with pathogenic oganisms. The value of crop rotation is thus rendered less reliable, and the dissemination of pathogenic organisms more rapid and serious.

The spores of F. annuum can withstand desiccation for hours, and thus are able to travel in dust storms for long distances without losing their vitality. Some experiments were performed to test this. Spores were transferred to a drop of sterile water on a series of slides, and were allowed to dry at ordinary room tem-

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*This bulletin was ready for the printer when an artice by H. G. MacMillan entitled "Wind and the Distribution of Pathogenic Soil Organisms" appeared in Phytopathology (Vol. 9, No. 10, pp. 471-473, Pl. XXXVI).

peratures.

The slides were divided into three groups; the first and the second groups were kept outdoors in the shade and in the sunlight, respectively, while the third group of slides was placed in an incubator. The temperature in the shade varied from 15° to 20° C.; in the sunlight it was 28° to 32° C.; while in the incubator it remained about 30°. Slides from each group were taken into the laboratory at regular intervals; a drop of sterile water was placed upon the film of the spores, and the slides were kept in a moist chamber. At the end of 24 hours they were examined under the microscope for germination. It was found that the spores kept their vitality for four hours in the direct sunlight, for forty-eight hours in the shade, and for six hours in the incubator.

A number of sterile platinum wires were dipped into the sporodochia of F. annuum, then capped with sterile paper and kept in the incubator at a temperature of 30° C. The vitality of these spores was tested every other day by transferring them to nutrient agar. The spores kept their vitality for eighteen days.

In order to determine the amount of protection afforded by the soil against desiccation, several samples of a sandy loam soil were chosen, placed in covered glass dishes and sterilized in the autoclave. Spores from the sporodochia of F. annuum were transferred to sterile water and the soil was saturated with this mixture and then allowed to dry thoroughly. This drying process required five hours. The spores require 8 to 9 hours to germinate; therefore none of the spores had time to form mycelium. The soil containing these spores was placed in an incubator at a temperature of 30° C. From time to time a bit of the soil was taken out and transferred to a plate of nutrient agar. The fungus was repeatedly re-isolated from the soil for a period of seven weeks, but it failed to grow at the end of that period.

The vitality of the mycelium was tested in the following experiment: Several samples of a sandy loam soil were sterilized and inoculated with the spores of F. annuum as previously outlined, but instead of allowing them to dry, they were kept moist for three days. This allowed the spores to germinate and to form mycelium. At the end of the third day the soil was dried and placed in an incubator at a temperature of 30° C. Cultures were made from these samples from time to time, and the fungus was re-isolated after ten months of desiccation.

Irrigation waters and methods of irrigation.—Chile peppers in New Mexico are grown under irrigation. The fields are either flooded or the water is allowed to run through furrows dug along-

side the plants. The importance of the running water as a disseminating agent should not be underestimated. Considerable quantities of dirt are washed away from one end of the field and are deposited along the route of the running water. Spores, bits of mycelium, and any pathogenic organisms which might be present in an infected part of the soil, will easily be carried along with the dirt and be distributed at quite a distance from their original source, establishing new centers of dissemination. A few days after the wilting of the diseased plants, large numbers of sporodochia appear on the underground stem, just below the surface of the soil. These can easily wash off in irrigation waters and their spores may be carried a great distance.

In order to demonstrate the ability of running water to carry spores present in the soil, the following experiment was conducted:- a glass tube four feet long and one inch in diameter was selected, both ends were plugged with sterile cotton, and it was heated red hot over a gas flame, allowed to cool, then it was filled three-fourths full with a sterilized sandy loam soil to which was added a solution prepared according to the following formula:

Ammonium nitrate	1 g.
Dihydrogen potassium phosphate	0.5 g.
Magnesium sulphate	0.25 g.
Cane sugar	5 g.
Water	100 c. c.

The tube was then placed in a slightly slanting position, and the dirt, by careful shaking, was distributed all along its entire length, thus leaving a space between the soil and the upper side of the tube. Spores of F. annuum were washed in a few c. c. of sterile water, and this was added to the soil about three inches inside of the upper opening of the tube. This solution was absorbed by the soil in an area of two inches, which was marked off. Then a gentle stream of sterile water was allowed to run from this end of the tube down to the opposite end until the entire soil was saturated. This process required less than two minutes. Thus the water ran over two inches of soil containing no spores, then over two inches of dirt to which water containing a large number of spores was added, and then over the rest of the soil in the four foot tube. After the soil was well wetted, the tube was plugged and laid aside. Two days later the mycelium appeared over an area of eighteen inches. Thus a gentle stream of water was found capable of carrying spores sixteen inches away from their original source. Under natural conditions dirt and spores may be carried

much further and cover large areas, since the irrigation water runs in furrows for a considerable length of time, varying from ten to fifteen minutes or more.

The best way to overcome this undesirable result of irrigation is to practice the ridging method of planting. The ridges should be made from eighteen to twenty-four inches high and four feet apart. Chile peppers which grow on top of these banks cannot come in direct contact with the running waters, and the moisture will go toward the roots by capillarity alone. The force of capillary movement of water in the soil is not strong enough to move the conidia of F. annuum through the spaces between the dirt particles. This was illustrated in the following experiment:—several Petri dishes were partially filled with a sandy loam soil to which the nutrient solution described in the preceding paragraph was added. The soil was then dried and sterilized in the autoclave. Spores of F. annuum were washed in sterile water and added, by means of a sterile pipette, to the center of the soil in the dishes. The water was applied drop by drop, allowing the soil to absorb each drop before adding another. This process was continued until most of the soil in the dishes was wet. That portion of the soil which was wetted by the direct contact of the water dropped from the pipette, was marked off from the soil wetted by capillarity; the remaining dry soil in the dishes was moistened by the application of sterile water. After two days the mycelium appeared as a white, dense, circular growth on the area which received the direct application of water containing spores; the rest of the soil remained sterile in every case. Similar results were obtained in another experiment:—several glass tubes, varying from two to twelve inches in length and having one-half inch diameter, were filled with a sandy loam soil; one end of the tubes was plugged with cotton and the other end covered with a layer of cheesecloth, and then they were sterilized in the autoclave. Spores of F. annuum were transferred to a number of beakers containing fifty c. c. of sterile water, and the tubes were placed in these beakers with the cheesecloth covered end in the water. After the water moved up the column by means of capillarity, samples of soil were taken from the upper ends of the tubes and plated. No growth was obtained in any of the cultures.

Descending or percolating waters, however, do carry spores with them. Several glass tubes four feet long and one inch in diameter were filled with a sandy loam soil, a few cubic centimeters of water containing spores was applied to the upper part of the

column, then distilled water was added until it passed through the entire column and began to drip out. When a drop of this was examined under the microscope, a number of typical F. annuum spores were observed.

Another advantage of the ridging method of planting and irrigation lies in the fact that the fungus will be prevented from spreading to the nearby rows through the roots of diseased plants. On the level ground the roots of the plants in the adjoining rows will always get tangled together, while the ridging method of planting confines them largely to the ridges. The fungus travels much faster in the plant tissues than it does in the soil. The greater part of the root system of a newly wilted plant is free from the fungus; within a week's time, however, the entire root system is invaded. This affords the fungus a very rapid means of spreading. For this reason large patches of infected areas appear within a short time around a diseased plant, when the level method of cultivation is practiced; but when the ridging method is used, rows of dead plants, instead of patches, appear in the field.

Direct growth of the fungus hyphae in the soil:—F. annuum has marked saprophytic properties and can grow readily in soils of ordinary fertility. The type or the structure of the soil has no influence upon the rate of the growth of this fungus. This fact was proven in the following experiment: very fine sand, sandy loam, loam, clay loam, and clay soils were selected and an equal amount of each was placed in Petri dishes. The nutrient solution, as described in the foregoing paragraph, was added to every sample. allowing the soil to saturate with it. The excess of water was removed by decantation and by the means of absorbent paper, then they were sterilized in the autoclave and inoculated with F. annuum. Ordinary field soil to which no nutrient solution was added was used as check. Fungus colonies appeared two days after the inoculation, and their diameters were measured from day to day as they grew, until the growth ceased; then five grams of soil was removed from every dish and the capillary moisture was determined. The rate of growth, which averaged a quarter of an inch a day at a temperature varying from 27°-30° C., remained constant in all of the different soil samples. The checks averaged a growth equal to that of the others, but the mycelium was thin and sparse, as compared with the dense and rich growth made on the soils to which nutrient solution was applied.

When the spores are disseminated by the irrigation waters and find suitable conditions, they soon germinate and attack the organic matter in the soil. By leading a saprophytic life the fungus

spreads in the layers of the soil. Its rate of growth, however, remains constant regardless of the amount of the organic matter. This was shown in the following experiment: A sandy soil was selected and placed in Petri dishes, filling them half full. These were divided into six groups; one group was used as check and received no organic matter, while the other groups received an application of 2, 4, 8, 10, and 15 per cent of organic matter, consisting of dried and powdered horse manure. The checks had only a trace of organic matter. These samples were sterilized in the autoclave and inoculated with F. annuum. The diameter of the ensuing fungus colonies was measured from day to day, and it was found that in all cases it averaged about a quarter of an inch a day at a temperature of 27°C.

Since ordinarily chile peppers are turned under after the harvest of the pods, the fungus will find sufficient food material for its growth and development. It may be argued that in the field where there are so many other soil organisms to compete with F. annuum will not be able to make as rapid a growth as it does under the laboratory conditions. The following experiment was conducted to see if other soil organisms exerted any hindering action upon the development of F. annuum: A number of Petri dishes were filled half full with a sandy soil. The nutrient solution was added to some of them, others received various applications of organic matter; fresh chile pepper roots were buried in the soil of a third group of dishes, and a fourth group was used as check. All the samples were saturated with water. These four groups of dishes were further divided into 2 subgroups; one was inoculated with F. annuum alone, while the other was inoculated with F. annuum, Rhizopus nigricans, an Aspergillus sp., a Penicillium sp., and an Alternaria sp. The spores from these different fungi were transferred to a small amount of water, and a drop of this water was used for inoculation. In all cases a mixed colony was the result. Except in the case where fresh chile pepper roots were used instead of nutrient solution or manure, Rhizopus nigricans outgrew all others, while F. annuum outgrew the Aspergillus, the Penicillium and the Alternaria species. Its rate of growth, however, remained constant, both in the mixed and in the pure cultures, averaging a quarter of an inch a day at a temperature of 27° C. In case of fresh chile pepper roots, F. annuum not only outgrew all others, but averaged a growth of more than one-half inch a day on ordinary roots, and about one inch a day on the rootlets.

In another experiment unsterilized field soil to which a little

nutrient solution was added, was inoculated with F. annuum and the ensuing growth watched from day to day. The other organisms present in the soil failed to exert any influence upon the normal rate of growth of F. annuum.

The direct growth of the fungus in the soil is largely dependent upon the amount of moisture present. It was seen that the type and structure of the soil had no direct influence upon the growth and the development of this organism.The moisture, therefore, remains as the chief controlling factor, but it, naturally, varies in different soils. The following table shows the relation of the fungus to the moisture content of different soils:—

Table III.—The Relation of F. Annuum to Moisture Content of Soils.

Type of Soil	Per cent soil moisture when growth of fungus stopped
Very fine sand	5.6 %
Fine sandy loam	7.3 %
Loam	8.5 %
Clay loam	9.2 %
Clay	10.5 %

It can be seen that the fungus requires a large amount of soil moisture to make an active growth. Ordinary green plants require much less, and can grow and function normally in soils the moisture content of which is not sufficient to induce a noticeable development of the fungus mycelium. This is perhaps why the wilt of chile peppers is invariably confined to wet soils.

Remains of diseased plants.—After the crop of chile pepper is harvested, the plants are allowed to remain where they grew until the time of plowing, when they are turned under. Naturally, there is much shifting of the plant remains, both diseased and healthy ones, so that the sources of inoculum are multiplied. It is of doubtful value to pull the plants out and destroy them, because when the plants are pulled, the diseased, weakened roots break off and remain in the soil. At the time of wilting only some of the roots are affected; if they are dug out and destroyed before the infection has time to spread to the entire root system, the results will prove more satisfactory. It is necessary to destroy all diseased plants. The fungus can keep its vitality under absolutely dry conditions for a long time. Spores from two-year-old cultures germinated very readily. These cultures were made on steamed chile pepper stems and kept in the laboratory; no rubber cap, sealing wax or paraffin was used to protect the cultures against drying. Some infected roots were kept in an incubator at an average temperature of 30° C. for nine months, and at the end of that period the fungus was isolated from them very readily. Others were dried at a temperature of 105° C. for seven hours, but the fungus was isolat-

ed from them repeatedly. On account of this remarkable vitality of the fungus the diseased plant remains constitute a very dangerous source of infection.

Cold frame infection of the seedlings.—While the writer has never observed any occurrence of wilt in the cold frames, it is entirely possible that after the soil is once infected, the fungus will be able to attack the seedlings which, upon being transplanted to the field before showing any symptoms, will serve as an excellent means of dissemination. Sterilization of the soil of the cold frames is a good practice and one that should be followed, in all cases.

Infection.—Infection generally takes place at the base of the underground stem or at the whorl of roots around it. When, during the transplanting operations, the seedlings are set too deep, any portion of the underground stem may become the seat of the infection, and the plants may wilt and die before many of the roots are attacked. No wound is necessary for the initial infection; the fungus penetrates the host through sound tissues, as inoculation experiments under controlled conditions have shown. The time between the initial infection and the eventual death of the host varies according to climatic and soil conditions and the resistance offered to the parasite. On an average, four or five weeks are sufficient to bring about a complete wilt of a full grown plant. Some succumb two weeks after the initial infection; others may resist for two or three months. After entering the host tissues the fungus develops readily and quite rapidly. If the initial infection is at the tip of the root, it gradually advances towards the stem and from there to the other roots, but in most cases before the entire root system is infected, the underground stem becomes so badly diseased that the plant dies. Then there follows an upward and a downward movement of the infection. The upward movement is very slow and restricted, especially when the fungus reaches the tissues of the plant above the ground. Nevertheless, it sometimes involves the lower part of the aerial stem. The downward movement, due to the large amount of moisture present in the tissues, is very rapid, so that within a week from the time of the wilting all the roots may become diseased.

Histological sections of the affected tissues show the fungus to be most abundant in the xylem and the phloem cells, but the hyphae can be seen in all tissues from pith to the bark or the cork cambium. Chlamydospores are often very abundant in the tissues of the cork cambium. No other types of spores have been observed.

Pathological physiology.—Wilting is not due to a mechanical plugging of the tracheal cells by the hyphae of F. annuum, nor to any toxic substance produced by the parasite. While the fungus hyphae are quite abundant in the conducting tissues of diseased plants, they do not occupy the vessels to such an extent as to stop the flow of the solutions. The fact that newly wilted plants are able to form new roots and foliage if given low enough temperature to check a rapid development of the parasite, is sufficient proof to show that toxic excretions play no part in the wilting of the chile peppers. This was further proven by the following experiment: the fungus was grown in Richard's solution at a temperature of 25° C. for four months. It made a very luxuriant growth and absorbed 1.15 per cent of the solids in the solution. At the end of four months the solution was filtered and chile pepper seedlings were transferred into the filtrate. Uninoculated Richard's solution and distilled water were used as checks. None of the seedlings showed any sign of wilting at the end of three days. A chemical analysis of the filtrate for the presence of alkaloids gave negative results.

The wilting is due to the breaking down of some of the invaded tissues, especially those of the cork cambium, the cambium, and the bark, and to the eventual girdling of the stem. This girdling has been closely followed in water cultures. The effect of the parasite upon the host, therefore, is a more or less rapid killing of the invaded cells rather than a complete clogging of the water conducting system.

ECOLOGY

Temperature.—Pepper plants thrive in warm climates and require a long growing season for their fruit to mature. The climatic conditions of New Mexico, especially those of the lower and warmer valleys, are well suited for the culture of chile peppers. The temperature is rather warm during the day, but it drops considerably at night. F. annuum requires not only a high, but a relatively constant temperature, as well, for its best development. The following table represents the average temperature of the soil of the Experiment Station farm for the years 1916 to 1918, inclusive. The temperature was taken three inches below the surface of the soil and recorded automatically:—

Table IV.—Average soil temperatures for the years 1916-1918.

	1916	1917	1918	Average
	°F	°F	°F	°F
January	58.4	44.4	46.5	49.8
February	53.4	50.2	47.6	50.3
March	61.6	53.6	61.2	58.8
April	63.7	60.6	68.4	64.2
May	68.3	65.3	70.2	67.9
June	75.1	76.9	77.2	76.4
July	77.0	84.0	76.6	79.2
August	75.3	80.3	76.3	77.3
September	70.8	79.2	77.0	75.7
October	64.2	71.8	64.7	66.9
November	55.6	64.4	49.8	56.6
December	53.4	53.2	43.2	49.6

The following table shows the air and the soil temperatures during the growing season of 1919:—

Table V.—Average soil and air temperatures for the growing season of 1919.

MONTH	Maximumsoil temperature	Minimum soil temperature	Maximum air temperature	Minimum air temperature
	°F	°F	°F	°F
April	63.4	50.3	75.4	44.7
May	68	55.5	84.3	50
June	78.5	64.1	91.2	58.8
July	87.3	75.8	91	66
August	86.7	75.5	92.9	64.5
September	74.3	67.9	82.5	59.2
October	68	59.9	74.2	48

June, July, August and September are the warmest months, as can be seen from the foregoing table. The first diseased plants appear during the latter part of June, but the largest number of infections take place in August. If there is a marked fluctuation of temperature, the disease may be expected to be checked somewhat. This point is illustrated in the following experiment: A number of water cultures were kept at a temperature of about 27°C. Two weeks after inoculation all plants, except checks, wilted. Another group of inoculated plants were kept in a room where the temperature was 20° C. during the daytime, and 15° C. at night. These plants wilted five to six weeks after inoculation. A third group was placed in an observatory where the temperature was 20°-22° during a part of the daytime, and 8°-10° at night. None of these plants wilted, and only the tips of the roots of some of them showed a brown discoloration. Newly wilted plants after being transferred to this observatory began to form new roots and foliage, but when taken back to the warmer room after making some growth, they wilted again.

Freezing does not seem to affect the vitality of the fungus. Nutrient agar cultures were frozen at a temperature of 12° F. overnight, and the next day when spores from these were transferred to hanging drop cultures, they germinated very readily within 8 to 10 hours.

Soil.—So far as the direct influence of the soil is concerned, F. annuum is not at all affected, as was shown by the fact that it grew equally well on all types of soils, other conditions being similar. The indirect influence of the soils, however, is of much importance, especially from the standpoint of their water holding capacity. The temperature differences of different types of soils are not so important as some think them to be. Haskell (4) believes that the relation of the soil type to the Fusarium wilt of potatoes is principally due to the difference in temperature, and that clay soils having a greater water holding capacity are cooler than sandy soils, the moisture content of which is much less. Bouyoucos (5) has shown that this difference is comparatively small, as can be seen from his figures, some of which are given in the following table:—

Table VI.—Seasonal and Yearly Average Temperatures of Different Types of Soil.

1914-15 Season	Sand Depth 4 in.	Loam Depth 4 in.	Clay Depth 4 in.
Winter			
Dec.	31.81°F.	33.56°F.	32.96°F.
Jan.	31.28 "	32.05 "	32.03 "
Feb.	32.73 "	32.13 "	32.31 "
Average	31.94 "	32.58 "	32.43 "
Spring			
Mar.	34.48°F	33.89°F	32.96°F
Apr.	54.36 "	52.95 "	32.03 "
May	58.11 "	56.37 "	32.31 "
Average	48.88 "	47.74 "	47.03 "
Summer			
June	68.55°F	66.42°F	65.46°F
Jul.	74.96 "	72.82 "	71.55 "
Aug.	70.00 "	68.06 "	68.17 "
Average	71.17 "	69.10 "	68.39 "
Autumn			
Sep.	67.41°F	65.90°F	65.47°F
Oct.	53.97 "	52.78 "	52.34 "
Nov.	41.52 "	41.45 "	41.18 "
Average	54.30 "	52.38 "	53.00 "
Yearly Average	51.60°F	50.70°F	50.21°F

The temperature of different soils taken at a depth of 12 or 18 inches shows the same relationship as that given in the above table. Therefore it is safe to conclude that this difference of temperature exhibited by different types of soils is not important enough to affect the chile wilt organism. Most of the wilt occurs during the middle of August and September, yet these months are, on the average, from 2 to 4 degrees cooler than July. The temperature, beyond a certain point (23°-25° C.), ceases to be a controlling factor in the development of this disease.

Moisture.—The greatest single controlling factor in the occurrence and the severity of this disease is the soil moisture. It has been a matter of common observation that the wilt of chile pepper is most serious in low, wet fields, on crop growing in heavy or clay

soils, and on undrained land. Chile pepper fields in the low and wet lands have suffered the most, while those situated on the uplands where there is natural drainage, have remained comparatively free from infection. The following extract from the letter of a farmer is very typical: "...the people on the river have almost gone out of the business of trying to raise chile. The trouble seems to be in the water of the Rio Grande River. I am back three miles from the river, and I have no trouble at all in growing the crop. People in the mountains grow it without difficulty." Low lands lying alongside the river do not as a rule have as good drainage as those on the uplands, and the wetter a soil is, the more susceptible will the crop be to the disease.

Heavy rains and general outbreaks of Fusarium wilt of chile peppers seem to go hand in hand. The records show that the wilt was very destructive in 1912, and that most of the damage was done in August. An unusually large amount of rainfall is recorded for that month, as can be seen from the following table:

Table VII.—Daily Rainfall in August, 1912.

August 2	0.13 inches
" 4	0.20 "
" 12	0.35 "
" 13	0.10 "
" 15	0.69 "
" 16	0.03 "
" 18	0.73 "
" 19	0.06 "
" 20	0.15 "
" 23	0.13 "
" 24	1.14 "
" 27	0.98 "
" 29	0.10 "
" 31	0.43 "
Total	5.04 "

July and August are rainy months. The humidity of the air and the moisture content of the soil are usually higher during these months than at other times. The fungus activities in the soil, due to these favorable conditions, accelerate in July, and manifest themselves in August.

Most of the irrigated fields have "low spots" or "wet pockets" where the moisture accumulates and cannot be drained off without some artificial means. When fields are leveled for irrigation, the land is given a more or less gentle slope; the lower part of this slope receives more water and loses less moisture by drainage than the upper parts. Chile plants growing in these low spots become heavily infected, and very often the entire crop in these sections becomes a total loss. This fact is corroborated by numerous observations and statements by farmers, county agents and members

of the Extension Division and Experiment Station staff of this College.

In co-operation with the Horticultural Division of this Station, four acres was planted to chile pepper and kept under close observation during the growing season of 1919. The cultural work of these plots was done under the direction of Prof. F. Garcia. Plot 1 was situated just at the border of the mesa; the soil was sandy, and the natural drainage excellent. Plot 2 was in a low field with a marked slope towards a public road. Plot 3 was in a cherry orchard and the plants were shaded by the foliage of the trees. Plots 4, 5, and 6 were in a field which, prior to the 1919 crop of chile peppers, was occupied by nothing but old peach trees. The first wilted plants were observed in the lower part of Plot 2 during the latter part of July. The infection began to spread rapidly in the wet pocket until in about two weeks nearly twenty per cent of the plants died. After that only an occasional plant wilted. The upper, drier part of the field showed less than two per cent infection. This field had been planted to chile peppers the previous year, and 50 to 60 per cent of the plants in the low and wet part of the plot were killed. It was only logical to expect a more serious infection during the growing season of 1919; but contrary to all expectations the number of the diseased plants fell to twenty per cent. The moisture content of the soil averaged 17 per cent; the moisture, therefore, was not the only controlling factor in this case. The writer can advance only one theory to explain this: nematode-infected plants seem to show a marked resistance to the Fusarium wilt. The great majority of plants in this plot were seriously affected by nematodes during the summer of 1919. In other plots, where nematode activities were not as noticeable, it was repeatedly observed that in areas infested with the wilt, nematode-infected plants were, in most cases, the only ones not killed by the wilt organism. This point is well illustrated in table 9, where most of the surviving plants in a wilt infested area are shown to be affected with nematodes. The heavier the nematode infection is, the more resistance the plants seem to show to the wilt. Chile plants suffering from nematodes remain stunted if attacked early in the season, branch sparingly or not at all, the leaves turn yellow, become wrinkled and brittle, and the rootlets do not grow, but remain as short, club-like stubs.

When the nematode infection in Plot 2 reached its maximum development in August, the Fusarium wilt stopped almost altogether; while in the other plots where nematodes were not serious, the wilt became most active in August and September.

The most serious outbreak of wilt occurred in Plot 5. Here the lower part of the field represented a low, wet pocket where 85 per cent of the plants were killed, while only two per cent of the plants growing in the upper part, not more than fifty feet away, wilted. Nearly four hundred soil samples were taken from these two parts of the Plot 5, and the capillary moisture content of the soil was determined. A fourteen-inch soil tube was used to take the samples. The figures given in the following tables represent the moisture of the upper foot of soil of the field:—

Table VIII.—Average Soil Moisture of Plot 5.

Upper Field	Per cent plants killed. .2	Lower Field	Per cent plants killed. .85
Minimum per cent soil moisture	Maximum per cent soil moisture	Minimum per cent soil moisture	Maximum per cent soil moisture
6.49	12.11	13.97	19.62

The minimum percentage of soil moisture represents the capillary water of the soil just before irrigation, while the maximum percentage of moisture refers to the capillary water of the soil one day after irrigation. It can be seen from the above table that the moisture content of the lower part of the plot is almost twice as much as that of the upper field, and the difference between the percentages of the diseased plants of the upper and the lower parts of the same plot is too obvious to require comment.

Three representative rows were selected from Plot No. 5 and soil samples for moisture determination were taken from the base of every fifth plant. The condition of the plant, whether healthy or wilted, was recorded. The samples were taken one week after irrigation. The table on the following page gives the results of these tests.

This table shows that the amount of soil moisture and the condition of the plants correlate quite constantly. A high moisture content runs parallel with a high percentage of diseased plants. A few infected plants may be found where the moisture content of the soil is low, just as there may be some plants growing in wet spots, and apparently not affected with the disease. This may be due to a low or high resistance in the plants to the disease, and to the absence or the presence of the fungus in the soil. The general average, however, is so striking in its effect that the role of soil moisture in the occurrence and the severity of the disease cannot be doubted. An examination of the following table will illustrate this point still further. Soil samples were taken from the base of every plant of a representative row in Plot 5, and the capillary moisture was determined. Each plant is described as dead, healthy,

Table IX.—Relation of Soil Moisture to Wilt of Chile.

ROW 1			ROW 2			ROW 3		
No.	Per cent of moisture	Condition	No.	Per cent of moisture	Condition	No.	Per cent of moisture	Condition
1	8.6	Healthy	1	8.6	Healthy	1	7.5	Healthy
2	9.8	Dead	2	12.1	"	2	9.8	"
3	11.1	"	3	9.8	"	3	11.1	"
4	13.6	"	4	11.1	"	4	12.3	"
5	12.3	"	5	12.1	Dead	5	14.9	Dead
6	14.9	"	6	13.6	"	6	19.0	"
7	17.6	"	7	9.8	Healthy	7	17.6	"
8	17.6	"	8	18.0	Dead	8	17.5	"
9	17.6	"	9	14.9	"	9	19.0	"
10	12.2	Healthy	10	16.2	"	10	17.6	Healthy
11	17.6	Dead	11	13.1	"	11	20.4	"
12	17.6	"	12	11.1	Healthy	12	19.0	"
13	19.0	"	13	13.1	Dead	13	13.6	"
14	16.0	"	14	12.1	Healthy	14	16.2	Dead
15	13.6	Healthy	15	11.1	"	15	12.3	Healthy
16	16.3	"	16	9.8	"	16	12.3	"
17	16.2	Dead	17	14.9	Dead	17	11.1	"
18	17.6	"	18	11.1	Healthy	18	13.6	"
19	13.6	Healthy	19	12.1	Dead	19	11.1	Dead
20	12.3	"	20	11.1	Healthy	20	12.3	Healthy
21	11.1	"	21	11.1	"	21	11.1	"
22	11.1	"	22	9.8	"	22	11.1	"
23	12.3	"	23	9.8	"	23	9.8	"
24	11.1	"	24	6.3	"	24	8.6	"
25	9.8	"	25	7.5	"	25	8.6	"

or affected with nematodes. Mild nematode infections have been described as healthy, since a slight attack of these worms does not seem to render the plant resistant to the wilt.

Table X.—The Relation of Soil Moisture and Nematodes to the Wilt of Chile.

No	Per cent moist.	Condi-tion	No	Per cent moist.	Condi-tion	No	Per cent moist.	Condi-tion	No	Per cent moist.	Condi-tion
1	9.8	*D	33	17.5	D	65	16.0	†N	97	11.1	§H
2	9.4	H	34	19.0	D	66	13.6	N	98	12.3	N
3	9.8	H	35	17.6	D	67	12.3	D	99	9.8	H
4	9.4	D	36	14.9	N	68	12.3	"	100	12.1	"
5	12.3	"	37	22.0	D	69	13.6	"	101	9.8	"
6	14.9	"	38	22.0	D	70	13.6	"	102	12.3	"
7	14.9	"	39	17.6	N	71	16.2	"	103	11.1	"
8	13.6	"	40	19.0	D	72	13.6	H	104	9.8	N
9	12.3	"	41	17.6	D	73	11.1	"	105	12.3	N
10	14.9	"	42	20.4	N	74	13.6	"	106	8.6	H
11	14.9	"	43	20.4	D	75	12.3	"	107	9.8	"
12	16.2	"	44	16.2	N	76	12.3	"	108	9.8	"
13	14.9	"	45	16.2	D	77	12.3	"	109	8.6	"
14	16.3	"	46	16.2	D	78	13.6	"	110	8.6	"
15	16.2	"	47	13.6	H	79	14.9	N	111	9.8	"
16	16.2	"	48	16.2	D	80	12.3	D	112	9.8	N
17	16.0	"	49	14.9	D	81	12.3	H	113	7.5	H
18	13.6	"	50	14.9	D	82	12.3	"	114	8.6	H
19	19.0	N	51	17.6	H	83	12.3	"	115	9.8	H
20	17.6	D	52	16.2	"	84	8.6	"	116	8.6	H
21	16.2	D	53	16.2	"	85	12.3	"	117	7.5	H
22	14.9	H	54	16.2	D	86	12.3	"	118	7.5	H
23	14.9	D	55	13.6	D	87	9.8	"	119	7.5	"
24	13.6	"	56	12.3	H	88	9.8	"	120	9.8	"
25	17.6	"	57	13.6	H	89	9.8	N	121	8.6	"
26	19.0	N	58	16.2	D	90	9.8	N	122	7.5	"
27	19.0	D	59	16.2	D	91	11.1	H	123	9.8	"
28	17.6	"	60	13.6	H	92	9.8	"	124	8.6	"
29	19.0	"	61	16.0	D	93	11.1	"	125	8.2	N
30	16.2	"	62	16.2	"	94	9.8	"	126	11.1	H
31	17.6	"	63	17.6	"	95	11.1	"	127	9.8	"
32	16.2	"	64	16.2	"	96	12.3	"	128	8.6	"

*Dead †Nematode §Healthy

In order to determine if there were other secondary causes affecting the host or the parasite, chemical and physical analyses of soil samples, both from the upper and the lower parts of Plot 5 were made. The results are tabulated in tables 11 and 12.

Table XI.—Chemical Analyses of Soils from Plot 5.

Sample No.	Per cent of total solids	Per cent CaO	Per cent CO2	Per cent Cl	Per cent SO3
Upper Field					
1	.256	.045	.011	.046	.057
2	.1'2	.034	.011	.036	.046
3	.140	.034	.011	.023	.037
4	.162	.045	.015	.033	.056
5	.208	.045	.011	.033	.054
Lower Field					
1	.114	.028	.015	.0'2	.027
2	.1'4	.028	.015	.023	.028
3	.168	.034	.015	.012	.029
4	.268	.034	.015	.035	.062
5	.170	.034	.020	.012	.047

This table shows that the difference between the upper and the lower soil is not large enough to have any appreciable effect upon the plants or the parasite, and that both soils are normal for New Mexico.

Table XII.—Physical Analysis of the soil from Plot 5.

Field	Per cent of sand	Per cent of silt	Per cent of clay
Upper	87.4	6.2	6.4
Lower	72.7	16.3	11.1

The soil of the upper field is, according to this analysis, sandy; while that of the lower part of the field is sandy loam. This will tend, naturally, to increase the water holding capacity of the soil, but the most important cause for the high moisture content of these low spots is to be attributed to the lack of drainage, rather than to the structure and texture of the soil.

Plants growing in Plot 1 remained free from the disease throughout the season. As stated before, this plot was situated just at the edge of the mesa and had good drainage. The maximum capillary moisture of this soil was about 12 per cent, and the minimum 4 per cent; this gives an average of 8 per cent, which is too low to promote the disease. It is true that no chile or any other crop was ever grown on this soil, but on the other hand, Plots 4, 5, and 6 were occupied, prior to their being planted to chile peppers, by nothing but peach trees. Therefore, a heavy outbreak in Plots 5 and 6, and no disease at all in Plot 1, cannot be explained by the theory of the presence and the absence of the organism causing it, but by the amount of moisture present in the soil. The upper part of Plot 5 was almost free from the disease, while the lower part of the same plot, only a short distance away, contained almost nothing else but

diseased plants. Plot 6 had a low, wet area in the middle. Almost all of the plants in this area were killed, forming a sharp contrast to the healthy plants bordering them and growing on higher ground. Similar cases have been observed in almost every chile field visited by the writer. Inoculation experiments in the field show the same results. Only five per cent of the inoculated plants in the upper part of Plot 4 wilted, as against 65 per cent of positive inoculations in the lower and wetter part of the same plot. This was demonstrated still further in the laboratory and under controlled conditions. A sandy soil was selected and divided into six lots. The first lot received no application of organic matter. Well powdered and dried horse manure was added to the other lots at the rate of 1, 2, 4, 8, and 10 per cent. These soil samples were placed in a number of test tubes which were divided into two groups. The soil in one group was kept saturated with water throughout the experiment, while the other was kept just wet enough to prevent the plants from wilting. Chile seedlings grown in sterile sand were transferred to these test tubes and inoculated with F. annuum by applying equal amounts of spore dilutions to each tube. Every third plant was used as check. Within three weeks all the plants growing in the wet soil wilted, while the checks, and those in the inoculated but drier soil, remained unaffected. If the soil is kept constantly wet, the amount of organic matter present does not have any effect upon the disease, as it was seen that plants growing in soils to which no organic matter was added wilted just as readily as did those planted in soils containing from one to ten per cent of organic matter. When no effort is made to keep the soil constantly wet after the first saturation, soils with higher organic matter will contain more moisture and retain it much longer than those with little or no organic matter. In laboratory experiments it was seen that seedlings growing in soils having no organic matter were the last to wilt.

SUMMARY AND CONCLUSIONS

A serious wilt of chile peppers, which since 1911 has been very destructive in New Mexico, is caused by a new species of Fusarium (section Martiella), for which the name F. annuum is proposed.

The symptoms of the disease are a sudden wilting of the foliage, a total destruction of root hairs, the browning of the roots and the breaking down of their cork cambium, the disintegration of the bark cells and the cambium of the underground stems, the smoky discoloration of the wood, the production of white or

bluish sporodochia on some of the underground stems, and the appearance of dark brown, sunken lesions on the underground stem and often on the base of the aerial stem.

The soil is the chief source of inoculum. Dust storms, irrigation waters, the direct growth of the fungus mycelium in the soil, diseased plant remains, and possibly infected seed beds are the principal sources of dissemination.

The wilting of the diseased plants is not due to a mechanical stoppage of the water conducting tissues by the hyphae of the parasite. The fungus does not produce any toxic substances which may affect the host. A general breaking down and disintegration of the invaded tissues is the cause of the wilt.

The soil temperature is closely related to the occurrence of the disease up to a certain degree. The heaviest outbreaks of the wilt occur in August and September.

The optimum temperature for the fungus is around 31° C., but the highest average soil temperature in the field is 25° C. The soil temperature is from 2 to 4 degrees higher in July than it is in August and September, yet most of the infection takes place in August and September. On the other hand, when the average soil temperature is much below 17° C., no infection is possible.

The soil moisture is the chief controlling factor. It was found that when the average capillary moisture was below 12 per cent, only 2 per cent of the plants wilted; but when it was much higher than 12 per cent, 85 per cent of the plants wilted. Five per cent of the inoculated plants in the drier soils wilted, as against 65 per cent of the positive inoculation in the wet soils. Laboratory experiments under controlled conditions gave similar results.

Since there is such a close correlation between high moisture content of the soil and the Fusarium wilt of chile peppers, it follows that anything which will check the soil moisture will also check the disease. In the first place, heavy soils should be avoided and light soils given preference. If the natural drainage of the soil is poor, artificial drainage will prove to be a good investment, as it will not only control the wilt, but will also improve the physical and the chemical condition of the soil. Too much emphasis cannot be placed upon an intelligent practice of irrigation. Irrgation should not follow a definite schedule, but the land should be watered only when the minimum amount of soil moisture falls below the actual needs of the plant.

Digging diseased plants and destroying them, sterilizing

seed beds, growing plants on high ridges instead of on level ground, and protecting the fields against the prevailing winds by the means of windbreaks are sanitary measures which will not fail to yield good results.

Crop rotation is of doubtful value, since even the virgin soils have been found to abound with disease producing organisms; nevertheless it is not a wise thing to overlook the fact that a certain degree of protection always exists with crop rotation, even under the unfavorable climatic conditions of New Mexico.

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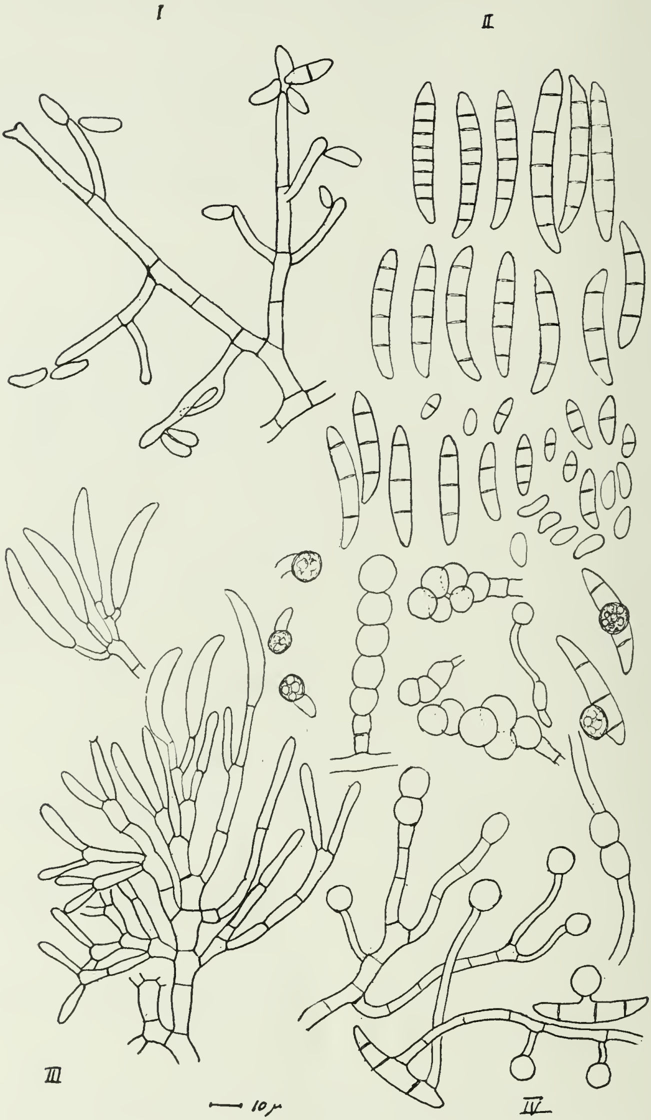

Fig. 7.—Fusarium annuum n. sp. (Drawn with the aid of camera lucida.)

I. Microconidiophore with conidia.
II. Conidia of various types.
III. Macroconidiophore with conidia.
IV. Chlamydospores and various methods of chlamydospore production.

BULLETIN NO. 122

February, 1920

New Mexico College of Agriculture and Mechanic Arts

Agricultural Experiment Station
State College, N. M.

MOSELLE LYONS OF RIVERSIDE, No. 94670
Year's record, 16968.1 pounds of milk, containing 600.88 pounds of butterfat

DAIRY COW FEEDING EXPERIMENTS

CORN SILAGE VS. ALFALFA HAY
DRIED BEET PULP VS. CORN SILAGE

By LUTHER FOSTER AND J. R. MEEKS

ALBRIGHT & ANDERSON, PRINTERS-BINDERS, ALBUQUERQUE

New Mexico Agricultural Experiment Station

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DAIRY COW FEEDING EXPERIMENTS*

EXPERIMENT No. 1

January 8, 1916, to May 8, 1916

CORN SILAGE vs. ALFALFA HAY

Alfalfa hay is easily produced in the irrigated portions of the State and usually large quantities may be purchased during the cutting season at a reasonable price. In the dry farming districts where alfalfa is not so readily produced cowpea hay† has proven fully equal to it in feeding value and not a single season has passed at the Tucumcari Station that a fair crop of it has not been grown. Under irrigation the numerous varieties of corn, the sweet sorghums and the Russian sunflower may be depended upon as silage crops, and under dry farming conditions where the corn crop is not so certain, kafir, milo and the other grain sorghums seldom fail to make at least sufficient growth for a good quality of silage. Even Russian thistle when properly handled makes a fair substitute for the above crops for making silage. Dairymen, therefore, in nearly all parts of the State have opportunity each summer to grow or purchase a sufficient quantity of hay and silage to carry their dairy herds thru the months when pasture is not available.

The benefits of silo construction are fast gaining recognition in this State, not only in the irrigated sections but also in the dry farming areas; due to the fact that the dry land crops often can be economically made use of only thru the use of the silo. Silage is, as a rule, considered one of the most efficient and economical sources of roughage for dairy and beef cattle when fed in connection with some leguminous roughage such as alfalfa or cowpea hay. It also gives very satisfactory results fed in connection with any kind of carbonaceous hay if sufficient cottonseed meal is added to balance the ration properly.

The object of this experiment was to determine the economic features of a roughage ration composed of alfalfa hay alone in comparison with a roughage ration consisting of alfalfa hay and corn silage, for milk production. Careful records were kept in order to emphasize economy in feeding dairy cows, and to determine the quantity of alfalfa hay that a definite quantity of corn silage would replace; and its effect, if any, on the quantity or quality of the milk produced.

*This bulletin was prepared largely by J. R. Meeks, formerly assistant animal husbandman of the New Mexico Exepriment Station.

†New Mexico Experiment Station Bulletin No. 108.

The cows used were chosen from the College dairy herd, and consisted of both pure breds and grades of the different breeds kept for instructional purposes, viz., Holsteins, Guernseys and Jerseys. Great care was exercised in their selection in order that the two lots of eight cows each would be as nearly uniform as possible; special attention being given to yield of milk, butterfat and the period of lactation. The two lots were selected and the feeding test started January 8, 1916, and continued until May 8, 1916, a period of 120 days. The experiment was divided into four periods, the lots being reversed to the opposite feed at the end of each 25 days, five days being given for the adjustment of the change in the roughage ration, the grain remaining the same.

At the beginning of the experiment the cows were weighed separately on three consecutive days and under as nearly the same conditions in regard to feed, water, and milking as possible. The average weight of the three days was considered as the starting weight, and the experiment as beginning at noon of the second day. The cows were weighed in the same manner on three successive days at the close of the experiment, and noon of the second day was considered the time the experiment closed. The average of the three weights was taken as the closing weight. Single weighings were considered sufficient for the ending of the 25-day periods.

THE RATIONS

Lot 1 was fed thirty pounds of corn silage per head daily, all the alfalfa hay it would eat in addition, and one pound of concentrate for each five pounds of milk produced.

Lot 2 was fed all the alfalfa hay it would eat and one pound of concentrate for each five pounds of milk produced.

The concentrate used in this experiment consisted of four parts milo, one part bran and one part cottonseed meal. Milo was used because at the time it was very much cheaper than corn. When prices of concentrates do not differ materially the dairy mixture used at the Experiment Station consists of 3 parts ground corn, 2 parts bran and 1 part cottonseed meal.

At the close of each twenty-five day period the lots were reversed to the feed of the other lot, so that during the experiment each lot had the silage for two alternate periods and each had alfalfa hay without silage for two periods. This arrangement tended to overcome any difference that might exist in the individuality, productivity or other conditions of the two lots of cows.

TABLE I.—FEEDS CONSUMED DURING THE FIRST AND THIRD PERIODS OF EXPERIMENT 1.

First Period, January 14 to February 8, 1916 (25 days)

Lot 1				Lot 2		
Name of Cow	Grain	Corn Silage	Alfalfa Hay	Name of Cow	Grain	Alfalfa Hay
	Pounds	Pounds	Pounds		Pounds	Pounds
Helen	117	...	...	Belle	125	...
Ruth	100	...	...	Piebe	125	...
Viola	218	...	...	Rose	200	...
Ada	100	...	...	Hazel	100	...
Red Wing ...	249	...	...	Penosa	175	...
Moselle*	300	...	...	Olive	100	...
Favori	75	...	...	Mabel	235	...
Golden	124	...	...	Coats	100	...
Totals...	1283	5626	4764		1160	6763
Third Period, March 14 to April 8, 1916 (25 days)						
Helen	109.5	...	...	Belle	59.5	...
Ruth	99.5	...	...	Piebe	125	...
Viola	150	...	...	Rose	171.5	...
Ada	84.5	...	...	Marion	163.5	...
Red Wing ...	230	...	...	Penosa	159.5	...
Moselle	286.5	...	...	Olive	100	...
Favori	101	...	...	Mabel	216	...
Golden	122.5	...	...	Coats	98	...
Totals...	1183.5	5396.5	4432		1093	6951
Totals of Feeds for First and Third Periods						
	2466.5	11022	9196		2253	13714

The cows named above were divided among the breeds as follows: Purebred Holstein-Friesians, Moselle and Piebe, grade Holstein-Friesians, Red Wing; purebred Guernseys, Viola, Hazel and Golden, grade Guernsey, Marion; purebred Jerseys, Penosa, Ada and Favori, grade Jerseys, Belle, Olive, Ruth, Mabel, Coats, and Helen; Crossbred Guernsey-Shorthorn, Rose.

*Full name, Moselle Lyons of Riverside. Her record is given on the front cover page.

TABLE II.—FEEDS CONSUMED DURING THE SECOND AND FOURTH PERIODS OF EXPERIMENT 1.

Lot 1			Lot 2			
Name of Cow	Grain	Alfalfa Hay	Name of Cow	Grain	Corn Silage	Alfalfa Hay
Second Period, February 13 to March 9, 1916 (25 days)						
	Pounds	Pounds		Pounds	Pounds	Pounds
Helen	114	...	Belle	125	...	...
Ruth	100	...	Piebe	125	...	...
Viola	150	...	Rose	200	...	...
Ada	100	...	Hazel	100	...	...
Red Wing	250	...	Penosa	175	...	...
Moselle	300	...	Olive	100	...	...
Favori	89	...	Mabel	235	...	...
Golden	125	...	Coats	100	...	...
Totals	1228	7066		1160	5774	4498
Fourth Period, April 13 to May 8, 1916 (25 days)						
Helen	100	...	Belle	88	...	...
Ruth	100	...	Piebe	112	...	...
Viola	150	...	Rose	175	...	...
Ada	75	...	Marion	143.5	...	...
Red Wing	238	...	Penosa	150	...	...
Moselle	262	...	Olive	100	...	...
Favori	100	...	Mabel	212	...	...
Golden	125	...	Coats	86.5	...	...
Totals	1150	7130		1067	5512.5	4490
Totals of Feeds for Second and Fourth Periods						
	2378	14196		2227	11286.5	8988

Table I shows the quantity of feed consumed by Lots 1 and 2 in periods 1 and 3. Lot 1 consumed more grain than Lot 2, as shown in the totals succeeding the tables. The grain fed was automatically regulated, since the cows were fed 1 pound of the grain mixture for every 5 pounds of milk produced per cow. Consequently a wide variation will be noted in the amount of grain given any one cow during the 25-day period, as well as the different cows. In periods 1 and 3, Lot 2 did not receive silage, while Lot 1 was fed silage at the rate of 30 pounds per head per day. However, since some of it was refused occasionally, the feed records do not show quite this amount. Lot 2 received no roughage except alfalfa hay, which was fed in racks in the corrals. The total amount consumed per day per cow is calculated from the total amount eaten by the eight cows during the 25-day period and is hence only the average quantity.

The totals of the feed eaten in these two periods show that 11022 pounds of corn silage replaced 4518 pounds of alfalfa hay, that is, every 244 pounds of silage fed saved 100 pounds of good alfalfa hay. This result indicates that when alfalfa hay is worth $20.00 per ton the feeding value of corn silage in $8.20 per ton.

Table II is very similar to Table I, inasmuch as it shows the amount of feed consumed in periods 2 and 4. In these two periods Lot 1 was fed alfalfa hay to replace corn silage and Lot 2 was fed both silage and alfalfa hay. It will be noted that the amount of grain eaten by both lots as represented in both Table I and Table II evidenced very little variation. Lot 2, in periods 2 and 4, consumed 264 pounds more corn silage than Lot 1 did in periods 1 and 3. However, Lot 2 consumed 482 pounds less alfalfa hay in periods 1 and 3 than Lot 1 did in periods 2 and 4 when fed no roughage but alfalfa. This difference may have been attributable in part to the fact that the alfalfa hay fed during these periods was of excellent quality. Further, the individuality of the cows in each lot may account for some variation in the amount of the respective feeds eaten. A comparison of these two periods shows a result more favorable to silage than that of the other two. In this it required only 216 pounds of corn silage to replace 100 pounds of alfalfa hay, making its feeding value $9.21 per ton when alfalfa was worth $20.00.

TABLE III.—MILK AND BUTTERFAT PRODUCED DURING THE FIRST AND THIRD PERIODS.

First Period, January 14 to February 8, 1916 (25 days)

Lot 1 (with silage)				Lot 2 (without silage)			
Name of Cow	Milk	Test	Butter-fat	Name of Cow	Milk	Test	Butter-fat
	Pounds	percent	Pounds		Pounds	percent	Pounds
Helen	474.5	3.9	18.50	Belle	523.5	3.8	19.89
Ruth	466	4.9	22.83	Piebe	622	3.2	19.90
Viola	682	4.6	31.37	Rose	900.5	2.9	26.10
Ada	458.5	6.6	30.26	Hazel	482.5	4.4	21.23
Red Wing..	1178.5	2.8	32.40	Penosa	837.5	4.1	34.34
Moselle	1478.5	3.4	50.27	Olive	464.5	5.6	26.01
Favori	418.5	4.9	23.77	Mabel	1168.5	3.0	35.06
Golden	557	3.7	20.60	Coats	438	4.6	20.15
Totals...	5713.5	Av'r'ge 4.02	230.00		5437	Av'r'ge 3.72	202.68

Third Period, March 14 to April 8, 1916 (25 days)

Helen	486	4.3	20.90	Belle	532	3.8	20.22
Ruth	437	4.6	20.00	Piebe	576.5	3.3	19.02
Viola	638.5	4.5	28.73	Rose	864.5	3.0	25.94
Ada	372	4 9	18.23	Marion	850.5	4.0	34.02
Red Wing..	1071	3.0	32.13	Penosa	667.5	5.3	35.38
Moselle	1255	3.1	38.91	Olive	470	5.1	23.97
Favori	437	4.7	20.54	Mabel	958	3.1	29.70
Golden	550.5	4.4	24.22	Coats	403	4.8	19.34
Totals...	5247	Av'r'ge 3.88	203.66		5322	Av'r'ge 3.90	207.59

Total Milk and Butterfat for First and Third Periods

	10960.5	3.95	433.66		10759	3.81	410.27

TABLE IV.—MILK AND BUTTERFAT PRODUCED DURING THE SECOND AND FOURTH PERIODS.

Second Period, February 13 to March 9, 1916 (25 days)

Lot 1 (without silage)				Lot 2 (with silage)			
Name of Cow	Milk	Test	Butter-fat	Name of Cow	Milk	Test	Butter-fat
	Pounds	percent	Pounds		Pounds	percent	Pounds
Helen	551	3.4	18.73	Belle	553.5	3.5	19.37
Ruth	446	4.6	20.52	Piebe	596	3.0	17.88
Viola	683.5	4.6	31.44	Rose	853	3.2	27.30
Ada	395.5	5.4	21.36	Hazel	351.5	5.1	17.93
Red Wing..	1177	2.6	30.60	Penosa	753	3.8	28.61
Moselle	1385	3.2	44.32	Olive	442.5	5.4	17.70
Favori	428.5	4.6	19.71	Mabel	960	3.2	30.72
Golden	580.5	3.7	21.48	Coats	351.5	4.8	16.87
Totals...	5647	Av'r'ge 3.69	208.16		4861	Av'r'ge 3.63	176.38

Fourth Period, April 13 to May 8, 1916 (25 days)

Name of Cow	Milk	Test	Butter-fat	Name of Cow	Milk	Test	Butter-fat
Helen	571.5	3.7	21.15	Belle	672	4.0	26.88
Ruth	525	4.5	23.63	Piebe	455	4.1	18.66
Viola	887.5	5.1	45.26	Rose	1064.5	2.9	30.87
Ada	450.5	5.7	25.68	Marion	886	4.0	35.44
Red Wing..	1386	2.5	34.65	Penosa	777	5.2	40.40
Moselle	1428	3.8	54.26	Olive	549.5	5.4	29.67
Favori	522.5	5.2	27.17	Mabel	1100.5	3.3	36.30
Golden	653	4.0	26.12	Coats	304.5	3.1	9.41
Totals...	6424	Av'r'ge 4.01	257.92		5809	Av'r'ge 3.92	227.66

Total Milk and Butterfat for Second and Fourth Periods

	12071	3.86	466.08		10670	3.78	404.04

Tables III and IV represent the amount of milk and butterfat produced by the different lots in each of the periods. Table III shows the quantity of milk and fat produced and the average test of the milk in periods 1 and 3, in which Lot 1 was fed corn silage and alfalfa hay as roughage and Lot 2 was fed no roughage except alfalfa hay.

Considering the totals following the tables, Lot 1 on alfalfa hay and silage produced 201.5 pounds more milk and 23.39 pounds more butterfat than Lot 2 on a straight alfalfa hay roughage ration. In the second and fourth periods, Lot 1 produced 1401 pounds more milk and 62.02 pounds more butterfat when fed no roughage but alfalfa hay, than did Lot 2 when fed a roughage ration of both alfalfa and silage. The individual cows in Lot 1 apparently were more persistent producers than those of Lot 2, because Lot 1 produced more milk and fat than Lot 2 in either case, when fed both corn silage and alfalfa hay or when fed alfalfa hay alone as a roughage. The butterfat in the milk produced by Lot 1 averaged .1 per cent higher in periods 1 and

3, when this Lot received corn silage in connection with alfalfa hay, than in periods 2 and 4 when a straight alfalfa hay roughage was fed; while with Lot 2 the average per cent of fat in the milk produced was .03 higher when the alfalfa roughage ration was fed. Consequently, it cannot be said that either of the roughage rations materially influenced the percentage of butterfat in the milk. By using different feeds dairymen and farmers may be able, and they generally are, to cause dairy cows to increase in milk production, but not in per cent of butterfat. The total amount of fat in the milk is influenced, therefore, by an increase in the amount of milk produced and not by efforts to increase the test (per cent of fat). Various experiments have proved this fact conclusively.

TABLE V.—WEIGHTS TAKEN DURING EXPERIMENT 1

Name of Cow	January			Av. Beg. Weight	February		March		April		May 8 Av. End'g Weight
	14	15	16		8	14	9	15	8	14	
Lot 1											
Helen	910	895	875	893	890	900	915	920	920	915	875
Ruth	950	960	955	955	970	945	990	990	965	955	950
Viola	1315	1350	1300	1321	1315	1320	1340	1325	1325	1340	1311
Ada	980	965	965	970	1000	985	985	990	1020	1010	991
Red Wing	1225	1230	1240	1232	1230	1275	1228	1260	1270	1250	1186
Moselle	1460	1430	1430	1440	1490	1460	1515	1480	1545	1500	1470
Favori	665	660	650	658	640	655	665	660	720	725	690
Golden	755	750	745	750	775	785	785	780	810	800	788
Lot 2											
Belle	850	865	825	847	860	885	895	890	850	860	831
Piebe	1190	1175	1155	1173	1200	1225	1285	1280	1270	1290	1313
Rose	1115	1121	1105	1113	1130	1160	1200	1210	1170	1200	1196
Hazel	1029	1000	1000	1009	1010	1060	1080	1975	960	1010	953
Penosa	1270	1270	1275	1272	1255	1275	1300	1290	1220	1285	1226
Olive	832	810	780	807	810	835	840	830	800	820	786
Mabel	970	980	980	976	1000	1000	985	1000	960	1015	986
Coats	1287	1275	1265	1275	1255	1310	1340	1325	1290	1345	1356

TABLE VI.—AMOUNTS AND COSTS OF FEEDS CONSUMED.

	Grain Pounds	Corn Silage Pounds	Alfalfa Hay Pounds
Periods 1 and 3			
Lot 1	2466	11022	9196
Lot 2	2253	.....	13714
Periods 2 and 4			
Lot 1	2378	.....	14196
Lot 2	2227	11286	8988
Average Feed Consumed per Cow per Day			
Period 1			
Lot 1	6.41	28.13	23.82
Lot 2	5.8	....	33.8
Period 2			
Lot 1	6.14	....	35.33
Lot 2	5.8	28.87	22.49
Period 3			
Lot 1	5.91	26.98	22.26
Lot 2	5.46	....	34.75
Period 4			
Lot 1	5.75	....	35.65
Lot 2	5.33	27.56	22.45
Total Feeds Consumed During the 100 Days Covered by Experiment 1			
Silage lots	4693	22308	18184
Alfalfa Hay lots	4631	.....	27910

Cost of Above Feeds

	Grain, @ $30 a ton	Corn Silage $3.50 a ton	Alfalfa Hay $10 a ton	Total Cost
Silage lots	$70.39	$39.04	$90.92	$200.35
Alfalfa Hay lots	69.46	....	139.55	209.01

The weights and gains shown in Table V are of no special significance, since the lots had the same feed and care, the silage being given during alternate periods. This table shows that Lot 1 lost 54 pounds during the 120 days and Lot 2 gained 147 pounds. This difference is very small and can not be attributed to any difference in the character of the feed or the quantity or quality of same. Further, the cows in Lot 2 were 210 pounds heavier than those of Lot 1 at the beginning and 391 pounds heavier at the close of the experiment, which may have some bearing on the 147 pounds of gain in weight by Lot 2 at the close of the 120 days. The physical condition of the cows in the respective lots, the weather conditions and the amount of water and intestinal matter in each animal would necessarily cause a slight variation in the average weight of each lot at the beginning and at the close of the experiment. Practically all the feed above maintenance went to production, whether fed silage and alfalfa hay or only alfalfa hay with the grain.

Table VI might well be termed the Feed and Cost Sheet, since it shows the amount of the various feeds eaten; the market prices paid for the same and the total cost of all feed consumed by each lot. It will be noted that in each case when silage was fed the cost of the feed was reduced, showing that it is more economical to feed corn silage

and alfalfa hay together than to feed alfalfa hay alone, when prices are the same as during this experiment. The data shown on this sheet should be of considerable service to the farmers of this section of the country, because corn or cane silage can be produced fairly cheaply and alfalfa hay is produced abundantly; thus making it possible for dairymen and stockmen to feed their livestock at a reasonable cost, if advantage is taken of the conditions for economical production. Silos may be filled with second crops, those planted after an earlier cash crop has been harvested, and the silage serves practically the same purpose as if planted and matured at an earlier period in the season. There are several kinds of crops that will make good silage planted as late as the middle of July.

TABLE VII.—GENERAL RESULTS, EXPERIMENT 1
(Lots alternating on silage)

	Lot 1 Corn Silage, Grain, and Alfalfa Hay	Lot 2 Corn Silage, Grain, and Alfalfa Hay
First Period		
Grain Consumed	1283 lbs.	1160 lbs.
Silage consumed	5626 "	....
Alfalfa hay consumed	4764 "	6763 "
Milk produced	5713.5 "	5437 "
Butterfat produced	230 "	202.68 "
Average per cent of butterfat	4.35	3.95
Total cost of feed	$52.89	$51.22
Second Period		
Grain consumed	1228 lbs.	1160 lbs.
Silage consumed	....	5774 "
Alfalfa hay consumed	7066 "	4498 "
Milk produced	5647 "	4861 "
Butterfat produced	208.16 "	176.38 "
Average per cent of butterfat	4.00	4.00
Total cost of feed	$53.72	$49.95
Third Period		
Grain consumed	1183 lbs.	1093 lbs.
Silage consumed	5396 "	....
Alfalfa hay consumed	4432 "	6951 "
Milk produced	5247 "	5322 "
Butterfat produced	203.66 "	207.59 "
Average per cent of butterfat	4.18	4.05
Total cost of feed	$49.46	$51.15
Fourth Period		
Grain consumed	1150 lbs.	1067 lbs.
Silage consumed	....	5512 "
Alfalfa hay consumed	7130 "	4490 "
Milk produced	6424 "	5809 "
Butterfat produced	257.92 "	227.66 "
Average per cent of butterfat	4.3	4.0
Total cost of feed	$52.85	$48.12
Summary of Above Data Periods 1, 2, 3 and 4		
Grain consumed	4844 lbs.	4480 lbs.
Silage consumed	11022 "	11286 "
Alfalfa hay consumed	23392 "	22702 "
Milk produced on silage and alfalfa hay, with grain	10960.5 " (with 433.66 lbs. fat)	10670 " (with 404.04 lbs. fat)
Milk produced on alfalfa hay with grain	12071 " (with 466.08 lbs. fat)	10759 " (with 410.27 lbs. fat)
Feed cost per cwt. of milk produced by silage and alfalfa hay, with grain	$ .934	$ .919
Feed cost per pound of butter fat	.236	.242
Feed cost per cwt. of milk produced by alfalfa hay, with grain	.883	.951
Feed cost per pound of butterfat	.228	.249

	Corn Silage, Grain, and Alfalfa Hay	Grain and Alfalfa Hay
Total amount of milk produced	21630 lbs.	22830 lbs.
Total cost of feed	$200.35	$209.01
Feed cost per cwt. of milk produced	.926	.915
Total pounds of butterfat produced	837.70	876.35
Feed cost per pound of butterfat	.235	.238
Excess of milk produced by the alfalfa hay and grain ration	....	1199.5 lbs.
Excess of butterfat produced by the alfalfa hay and grain ration	....	38.65 "
Feed cost of excess milk	....	$ 8.66
Feed cost per hundredweight of excess milk	....	.72

SUMMARY OF EXPERIMENT No. 1

1. From Table No. VII the amounts of corn silage, alfalfa hay, and grain consumed by each lot will be noted. The addition of corn silage lowered the cost of the ration in each case except with Lot 1 during the first period, but on the average it did not lower the cost of milk production. The amount of milk was increased 276.5 pounds for the first period, which reduced the cost of production below that of Lot 2.

2. Lot 1 consumed 39,258 pounds of feed and produced 23,031 pounds of milk and Lot 2 consumed 38,468 pounds of feed and produced 21,429 pounds of milk during the four 25-day periods. This difference was doubtless due in part to the individuality of the cows composing the two lots. Since the lots were reversed in feed at the end of each period the difference in yield of milk had no effect of importance on the general result.

3. Lot 1 produced 10,960.5 pounds of milk and 433.66 pounds of butterfat when fed a ration of corn silage with alfalfa hay and grain (nutritive ratio 1:4.61), and when fed alfalfa hay alone with grain (nutritive ratio 1:3.27) it produced 12,071 pounds of milk and 466.08 pounds of butterfat. Lot 2 produced 10,670 pounds of milk and 404.04 pounds of butterfat when fed a ration of corn silage, alfalfa hay, and grain (nutritive ratio 1:4.61), and when fed alfalfa hay alone with grain (nutritive ratio 1:3.77) it produced 10,759 pounds of milk and 410.27 pounds of butterfat. In each case the amounts of milk and butterfat were increased by the change to a narrow ration which was the result of the silage being removed from the ration.

4. The total excess of milk produced by grain and alfalfa hay over that produced by silage, grain and alfalfa hay was 1,199.5 pounds, containing 38.65 pounds of butterfat. Using the current prices of feeds during the experiment the cost of producing the 1,199.5 pounds of excess milk was $8.66 or $0.72 per hundredweight, and should be considered very economical.

5. The total cost of feed, supplementing alfalfa hay with corn silage, was $200.35; and when corn silage was removed from the ration the total cost was $209.01. Therefore, the addition of corn silage to the ration lowered the total cost of production $8.66, but the extra quantity of milk produced fully covered the greater cost of the alfalfa hay ration.

6. A summary of the above statements evidenced the fact that the addition of corn silage to the ration made a more palatable and

slightly wider ration, as well as lowering the cost of production. The removal of corn silage from the ration, lowered the nutritive ratio and increased the production of milk and butterfat during the four 25-day periods.

EXPERIMENT No. 2

January 9, 1917, to May 4, 1917

CORN SILAGE vs. ALFALFA HAY

This experiment was outlined as an exact repetition of Experiment No. 1. The object of these experiments was to ascertain the economy of supplementing alfalfa hay with corn silage for milk production. For this purpose two lots of cows from the College herd were selected, due care being exercised to have the animals of the two lots as nearly identical as possible in regard to the stage of the lactation period, the quantity of milk, and the per cent of butterfat.

The alfalfa hay used in this experiment was of the best grade. The corn silage was also very good and the cows seemed to relish it. To one lot silage was fed in the morning and the hay at night and to the other hay was fed both morning and night. The grain mixture was made up of 3 parts ground corn, 2 parts mill run bran, and 2 parts dried beet pulp. As in the former experiment the mixture was fed at the rate of one pound to five of milk produced; and was given in two feeds daily, at the time of milking. The cows were all in good health and held their milk flow very uniformly.

The experiment was conducted during four twenty-five day periods and the feed of the two lots was reversed at the end of each period. The weighings were made at the beginning and end and also during the experiment in the same manner as in Experiment No. 1.

TABLE VIII.—FEEDS CONSUMED DURING EXPERIMENT 2.
First Period, January 9 to February 3, 1917 (25 days)

Lot 1				Lot 2			
Name of Cow	Grain	Corn Silage	Alfalfa Hay	Name of Cow	Grain	Corn Silage	Alfalfa Hay
	Pounds	Pounds	Pounds		Pounds	Pounds	Pounds
Favori	102.5	...	...	Piebe	124	...	...
Coats	97.5	...	...	Ruth	125	...	...
Rose	188	...	...	Gipsy	100	...	...
A. S. A. P. .	75	...	...	Ada	150	...	...
Totals...	463	3090	1875	Totals	499	...	3096

Third Period, March 10 to April 4, 1917 (25 days)

Favori	125	...	...	Piebe	124	...	...
Coats	75	...	...	Ruth	125	...	...
Rose	224	...	...	Gipsy	100	...	...
A. S. A. P. .	75	...	...	Ada	150	...	...
Totals...	499	3625	1904	Totals	499	...	3138

Total Feed for First and Third Periods

	962	6715	3779		998	...	6234

Second Period, February 8 to March 5, 1917 (25 days)

Favori	125	...	...	Piebe	125	...	...
Coats	75	...	...	Ruth	125	...	...
Rose	184	...	...	Gipsy	100	...	...
A. S. A. P. .	75	...	...	Ada	150	...	...
Totals...	459	...	2936	Totals	500	3435	2175

Fourth Period, April 9 to May 4, 1917 (25 days)

Favori	125	...	...	Piebe	71.5	...	...
Coats	71.5	...	...	Ruth	121.5	...	...
Rose	200	...	...	Gipsy	100	...	...
A. S. A. P. .	75	...	...	Ada	146.5	...	...
Totals...	471.5	...	2829	Totals	439.5	3625	1627

Total Feed for Second and Fourth Periods

	930.5	...	5765		939.5	7060	3802

The breeding of the above cows was as follows: Favori, A. S. A. P., and Ada, purebred Jerseys; Coats and Ruth grade Jerseys; Piebe a purebred Holstein-Friesian; Gipsy a purebred Guernsey and Rose a crossbred Guernsey-Shorthorn.

TABLE IX.—MILK AND BUTTERFAT PRODUCED DURING EXPERIMENT 2.
First Period, January 9 to February 3, 1917 (25 days)

Lot 1 (with silage 1st and 3d periods; without silage 2d and 4th periods)				Lot 2 (without silage 1st and 3d periods; with silage 2d and 4th periods)			
Name of Cow	Milk	Test	Butterfat	Name of Cow	Milk	Test	Butterfat
	Pounds	percent	Pounds		Pounds	percent	Pounds
Favori	620.8	4.4	27.31	Piebe	538	3.2	17.22
Coats	390	5.2	20.28	Ruth	545.3	4.3	23.45
Rose	989	3.3	32.64	Gipsy	433.6	4.8	20.81
A. S. A. P...	301.1	6.2	18.67	Ada	741	4.8	35.57
Totals...	2300.9	Av. 4.3	98.90		2257.9	Av. 4.3	97.05
Third Period, March 10 to April 4, 1917 (25 days)							
Favori	615.7	4.8	29.55	Piebe	348.9	3.5	12.21
Coats	299.6	5.0	14.98	Ruth	498.7	4.5	22.44
Rose	961.5	3.3	31.73	Gipsy	407.4	5.2	21.18
A. S. A. P...	342.1	6.0	20.53	Ada	625.3	5.5	34.39
Totals...	2218.9	Av. 4.3	96.79		1880.3	Av. 4.8	90.22
Total Production for First and Third Periods							
	4519.8	...	195.69		4138.2	...	187.27
Second Period, February 8 to March 5, 1917 (25 days)							
Favori	588.9	4.5	26.50	Piebe	534.7	3.3	17.65
Coats	332.6	4.8	15.96	Ruth	521.6	4.6	23.99
Rose	1004.8	3.3	33.16	Gipsy	427.1	5.2	22.21
A. S. A. P...	318.7	5.6	17.85	Ada	648.8	5.2	33.73
Totals...	2245	Av. 4.2	93.47		2132.2	Av. 4.6	97.58
Fourth Period, April 9 to May 4, 1917 (25 days)							
Favori	553.7	5.0	27.69	Piebe	176.9	4.0	7.08
Coats	152.2	4.5	6.85	Ruth	501	4.8	24.05
Rose	912.9	3.6	32.86	Gipsy	406.5	5.0	20.33
A. S. A. P...	310.4	6.0	18.62	Ada	582.9	5.3	30.89
Totals...	1929.2	Av. 4.4	86.02		1667.3	Av. 4.9	82.35
Total Production for Second and Fourth Periods							
	4174.2	4.3	179.49		3799.5	4.7	179.93

Table VIII shows the feed eaten by each lot and the amount consumed by each cow by periods. A slight difference is noticeable in the amounts of the various feeds consumed. In the first period Lot 1 consumed 30.9 pounds of corn silage, 18.75 pounds of alfalfa hay, and 4.63 pounds of grain mixture per cow per day; while Lot 2 consumed 4.99 pounds of grain mixture and 30.96 pounds of alfalfa hay per cow per day. During this period 30.9 pounds of corn silage replaced 12.21 pounds of alfalfa hay.

In the third period, Lot 1 consumed 4.99 pounds of grain mixture, 36.25 pounds of silage, and 19.04 pounds of alfalfa hay per cow per day; while Lot 2 consumed a daily ration of 4.99 pounds of grain and 31.38 pounds of alfalfa hay per cow, showing a slight increase in the amount of feed eaten. In this case it took 36.25 pounds of silage to replace 12.34 pounds of hay.

In the second period Lot 1 consumed 4.59 pounds of grain mixture and 29.36 pounds of alfalfa hay per cow per day. Lot 2 consumed 5 pounds of grain, 34.35 pounds of silage, and 21.75 pounds of alfalfa hay per cow per day. 34.35 pounds of corn silage was required to replace 7.61 pounds of alfalfa hay.

In the fourth period Lot 1 consumed a daily ration of 4.71 pounds of grain mixture and 28.29 pounds of alfalfa hay. Lot 2 consumed 4.39 pounds of grain mixture, 36.25 pounds of silage, and 16.27 pounds of alfalfa hay. During this period of the test 36.25 pounds of silage proved equal to 12.02 pounds of hay. From these data a slight variation will be noted in the quantity of feed eaten. The variation in the amount of grain eaten was due to the fact that the grain mixture was fed at the rate of one pound to five pounds of milk produced, while the differences in the amount of silage and alfalfa hay were due to some extent to the character of the feed, but largely to the individuality of the cows.

Table IX shows the milk and butterfat produced by periods and a careful analysis of the tables will show slight variations. In the first and third periods Lot 1 showed but little variation, while Lot 2 showed a variation of 377.6 pounds of milk and 6.83 pounds of butterfat between the results obtained in the first and third periods.

In the second and fourth periods the variation was greater. Lot 1 showed a variation of 315.8 pounds of milk and 7.45 pounds of butterfat, while Lot 2 showed a variation of 464.9 pounds of milk and 15.23 pounds of butterfat. The variations were much greater for the second and fourth periods than for the first and third periods. These variations were, no doubt, due to the stage of lactation and individuality of the cows.

The first and last weights were the averages of three weighings, while the others are only single weights. All weights were taken at 6:00 P. M.

From the above table it will be noted that all the cows in both lots gained in weight during the experiment. The average gain for Lot 1 was 105 pounds; and for Lot 2, 154 pounds. Great care was taken that each weighing be made under exactly the same conditions as regards the time of weighing and its relation to the hour of feeding and watering. The gain in weight was very uniform and the reason for the gain could not be attributed to the feeding of any particular roughage. As a rule, cows gain in weight as the warm weather comes, after a few disagreeable winter days, and the increased weight should be attributed more to desirable weather conditions than to the feed consumed; especially since the gains were gradual and very uniform.

TABLE X.—WEIGHTS OF COWS DURING EXPERIMENT 2.

Name of Cow	Jan'ry 9	February 3	February 8	March 5	March 10	April 4	April 9	May 4
	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
Lot 1								
Rose	1037	1135	1160	1185	1180	1140	1110	1050
Favori	723	740	740	765	765	750	780	780
Coats	1320	1320	1350	1350	1350	1375	1360	1385
A. S. A. P..	853	960	980	1030	1040	1040	1050	1040
Lot 2								
Piebe	1193	1310	1310	1355	1340	1380	1415	1470
Ruth	920	1010	1000	1005	990	990	1000	1010
Gipsy	906	1020	1040	1040	1030	1020	1050	1025
Ada	933	990	1010	1030	1000	990	1010	1020

TABLE XI.—GENERAL RESULTS, EXPERIMENT 2.
(Lots alternating on Silage)

Corn Silage and Alfalfa Hay with Grain	Lot 1 Periods 1 and 3	Lot 2 Periods 2 and 4
Grain consumed	962 lbs.	939 lbs.
Corn silage consumed	6715 "	7060 "
Alfalfa hay consumed	3779 "	3802 "
Milk produced on grain, silage and hay	4519.8 "	3799.5 "
Butterfat produced on grain, silage and hay	195.69 "	179.93 "
Feed cost per cwt. of milk	$ 0.997	$ 1.19
Feed cost per pound of butterfat	$ 0.230	$ 0.252
Alfalfa Hay with Grain	**Lot 1 Periods 2 and 4**	**Lot 2 Periods 1 and 3**
Grain consumed	930 lbs.	998 lbs.
Alfalfa hay consumed	5765 "	6234 "
Milk produced on grain and hay	4174.2 "	4138.2 "
Butterfat produced on grain and hay	179.49 "	187.27 "
Feed cost per cwt. of milk	$ 1.02	$ 1.114
Feed cost per pound of butterfat	$ 0.238	$ 0.246
Final Results	**Both Lots**	
Total milk produced by silage and hay with grain	8319.3 lbs.	
Total butterfat	375.62 "	
Total cost of feed	$90.54	
Feed cost per cwt. of milk	$ 1.088	
Feed cost per pound of butterfat	$ 0.241	
Total milk produced by alfalfa hay and grain	8312.4 lbs.	
Total butterfat	366.76 "	
Total cost of feed	$88.92	
Feed cost per cwt. of milk	$ 1.069	
Feed cost per pound of butterfat	$ 0.242	
Excess of milk produced by silage and hay with grain	6.9 lbs.	
Excess of butterfat produced by silage and hay with grain	8.86 "	
Excess of total cost of milk produced by silage and hay with grain	$ 1.62	
Excess of cost per cwt. of milk produced by silage and hay with grain	$ 0.019	

In figuring the cost the prices of feeds were considered the same as in Experiment No. 1, viz., grain mixture $30.00 per ton, alfalfa hay $10.00, and corn silage $3.50.

SUMMARY OF EXPERIMENT No. 2

1. Table XI shows the final results obtained in this experiment, indicating the amount of grain, corn silage, and alfalfa hay consumed by each lot and the amount of milk produced by each lot while on the respective feeds. It will be noted that Lot 1 produced more milk than Lot 2 when fed silage and alfalfa hay with grain, and that this lot also produced more milk than Lot 2 when fed alfalfa hay and grain and no silage. This was, no doubt, attributable to the individuality of the cows in the respective lots rather than to the kind of feed consumed.

2. Lot 1 consumed 18,151 pounds of feed and produced 8,694 pounds of milk, and Lot 2 consumed 19,033 pounds of feed and produced 7,937.7 pounds of milk; showing that the individuality and productive condition of the cows of the two lots varied more widely than was anticipated. But this fact has no special bearing on the results of the experiment, since the rations alternated between the lots.

3. The differences in the total quantity of milk produced by corn silage and alfalfa hay with grain as compared with the total milk produced by alfalfa hay alone with grain was only 6.9 pounds. This amount was in favor of the addition of silage to the ration, but it is too slight to be considered.

4. The addition of silage to the ration gave a wider nutritive ratio, of course, in each case. With Lot 1 the wide ration produced more milk, and with Lot 2 the narrow ration produced more. The excess milk produced by Lot 1, on the wide ration, was 345.6 pounds; while the excess milk produced by Lot 2, on the narrow ration, was 338.7 pounds. It will be noted that in the previous experiment, with a single exception, the narrow ration produced more milk in each case.

5. In the previous experiment the addition of corn silage to the ration lowered the cost of production, but in this experiment the addition of silage raised the cost of production $1.62 (all feeds being figured at the prices given in Experiment No. 1). However, when the cost of production is computed at more recent prices, considering grain at $60.00 per ton, corn silage at $8.00 per ton, and alfalfa hay at $20.00, the result is $10.11 in favor of the ration of grain and alfalfa hay with no silage. The cost of production does not differ greatly with the two rations but by the use of silage, a feed that has no ready market, there is a saving of alfalfa hay, a cash crop for which there is always a good market.

The following is taken from Bulletin No. 98 of this institution on "Economic Feeding for Milk Production."

EXPERIMENT 9

February 15 to May 26, 1914

ALFALFA HAY AND GRAIN vs. ALFALFA HAY, GRAIN AND SILAGE

This experiment was planned to determine the effect of adding silage to a hay and grain ration, on the production and cost of the milk.

In the irrigated sections of the State, where pastures provide the natural succulent feed during most of the year and alfalfa furnishes a very palatable winter roughage, it might seem that there is little need of the silo. In the dry farming sections the silo is indispensable to profitable, year-round dairying, and there the inexpensive pit silo furnishes the logical solution. But in the irrigated sections the silo question is not so easily disposed of. Wood silos seldom prove satisfactory anywhere in the State, and other types are expensive. Cement is the most promising silo material, but men with experience in their construction are scarce in this part of the country. Thus it may be seen that silage must be proved to be of real importance and economic benefit in milk production, under the conditions in the irrigated valleys of the State, before the construction of silos can be recommended for the valleys.

PLAN

The cows were divided into two very even lots of four each. The experiment consisted of two feeding periods of forty-seven days each with a seven-day interval to interchange rations. Both lots were fed grain alike, one pound for each five pounds of milk. During the first period, Lot 1 received fifteen pounds of alfalfa per head daily and thirty pounds of silage. Whenever the silage was not cleaned up, the remainder was weighed back and subtracted from the amount fed. A few of the cows were unable to handle that much silage regularly in addition to the allowance of hay. Lot II was fed all the alfalfa hay they would clean up. During the second part Lot II received silage, and Lot I the grain and hay alone.

FEED

The silage used for the first two weeks of the experiment was composed of kafir and cane and had some weeds in it. After that the silage was pure Indian corn. The alfalfa hay used was choice and a good grade of No. 1. The hay was fed in open feed boxes in the dry lots, all the cows in each lot being fed together. The silage was fed in the mangers in the milking stable, just after milking, fifteen pounds at a feed. The grain consisted of a mixture of ground wheat four parts, and bran one part, and was fed as usual, morning and evening at milking time.

TABLE 12.—FEED CONSUMED

Lots Fed Silage	Alfalfa Hay; lbs.	Silage; lbs.	Grain; lbs.	Total Cost of Feed
Period 1, Lot I	2820	5395	799	$34.85
Period 2, Lot II	2820	5602	778	34.87
Both Periods	5640	10997	1577	69.72
Av. per cow per day	15	29	4.2	.185
Lots Fed No Silage				
Period 1, Lot II	6917	....	752	$45.86
Period 2, Lot I	6205	....	799	43.01
Both Periods	13122	....	1551	88.87
Av. per cow per day	35	....	4.1	.236

The prices of the feeds were as follows: Alfalfa hay, $10.00 per ton; silage, $3.25 per ton; grain, $1.50 per hundredweight.

From the above figures it will be seen that the cows fed no silage consumed more alfalfa hay by twenty pounds per head daily, thus greatly increasing the cost of their feed. Table 13 shows the amount and cost of production, change in body weight of the cows, and cash return for each ton of hay.

TABLE 13.—RESULTS OF EXPERIMENT 9.

Lots Fed Silage	Milk Produced, lbs.	Butterfat Produced, lbs.	Value of Products	Cost of Feed	Feed Cost per cwt. of Milk	Feed Cost per lb. of Butterfat; cts.	Change in Weight; lbs.	Returns for Alfalfa, per ton
Period 1, Lot I ..	3506	159.2	$54.77	$34.85	$ .994	21.9	+122	$24.13
Period 2, Lot 11 .	3980	195.5	66.61	34.87	.876	17.8	–55	32.51
Both Periods	7486	354.7	121.38	69.72	.931	19.6	+67	28.32
Lots Fed no Silage								
Period 1, Lot II .	3968	188.5	$64.49	$45.86	$1.156	24.3	+30	$15.39
Period 2, Lot I ..	3575	159.0	54.85	43.01	1.203	27.0	–67	13.81
Both Periods	7543	347.5	119.34	88.87	1.178	25.5	–37	14.64

These figures show the two rations practically equal in the production of milk and butterfat, but there is a striking difference in the cost of the feed and hence in the cost of milk and fat produced. The silage ration produced milk and butterfat at 93.1 cents per hundred and 19.6 cents per pound, respectively, whereas the hay ration costs were $1.178 per hundredweight and 25.5 cents per pound.

If the price of the hay had been $6.00 per ton, instead of $10.00, the advantage of the silage ration, in cost of production, would nearly disappear. On that basis the feed which four cows ate during the ninety-four days of the test would cost $58.44 for the silage ration and $62.63 for the hay ration. This difference would not seem to justify the silo, if the hay as fed to the cows were not worth more than six dollars per ton as a market proposition.

The most striking figures in the table of results are those of returns for each ton of alfalfa. The silage ration yielded products which, after deducting cost of silage and grain, were worth $28.32 for each ton of alfalfa hay eaten, and the hay ration returned $14.64 for each ton of hay. The first figures give a hint of how it is possible for the Northern dairymen to pay twenty to twenty-two dollars per ton for alfalfa hay to feed to their dairy cows. These figures, however, are apt to lead to wrong conclusions. The cows which received no silage marketed more than twice as much hay as the silage fed lots, and thus the net profits are not so much larger for the silage fed lots, as appears from the returns per ton of hay. The lower the actual

cost of the alfalfa the less would be the profit in favor of the silage. If the alfalfa had cost $4.40 per ton in this experiment, all other costs and figures remaining the same, there would have been exactly the same profit with both rations. If the silage cost more or less than the $3.25 per ton, as figured, the advantage of feeding silage would, of course, decrease or increase.

CONCLUSIONS

Silage in the ration will take the place of much of the higher priced alfalfa, probably to the extent of one-half, when the cows are fed all the hay they will eat. The silage will decrease the cost of feed, if the alfalfa is worth more than six dollars per ton, without decreasing the production of milk and butterfat.

Home-grown alfalfa which cannot be profitably marketed will make the feeding of silage of doubtful economic value.

Where pasture is available most of the year, with oftentimes cheap unmarketable alfalfa for winter feeding, the silo does not seem to hold as important a position in the irrigated valley dairying in New Mexico as it holds in most other regions. This does not mean that the silo would not be profitable, but only that with the conditions as stated above it is not essential to successful dairying.

GENERAL SUMMARY

CORN SILAGE vs. ALFALFA HAY

1. Taking the average of the two experiments, the addition of a thirty-pound ration of corn silage to an alfalfa hay and grain ration made a saving of 30% of the hay, but it did not reduce the cost of the ration.

It required three tons of silage to replace one ton of alfalfa hay. Considering the hay at $10 per ton and the silage at $3.50 per ton, there was little difference in the cost of the two rations; but the milk product of the alfalfa ration was 4% greater than that of the silage, and the butter 2.4% greater.

2. Even though the experiments showed little difference in the cost and results of feeding the two rations, the use of the silo for the storage of cheap roughage that might otherwise be largely wasted would assist much in reducing to a minimum the grain and other cash crops used in feeding the dairy herd.

3. The results of these tests are not in accord with the common belief in regard to corn silage, since they do not show that it either lowered the cost of the ration or of the production. Neither is there any evidence that the addition of silage to a ration of alfalfa hay, on account of its succulence, increases the milk flow or keeps the cow in a more healthy condition.

4. Feeders often compare corn silage and alfalfa hay pound for pound in estimating their feeding values. This is erroneous, since the dry matter in corn silage is 26.3 per cent, while that of alfalfa hay is 91.4 per cent; and comparing their digestible nutrients, 100 pounds of alfalfa hay contains about three times as much digestible matter as 100 pounds of corn silage.

5. The total digestible nutrients in 100 pounds of corn silage is 17.7 pounds, while in 100 pounds of alfalfa hay there is 51.6 pounds. Therefore, considering digestibility only, it would require 2.9 pounds of corn silage to replace one pound of alfalfa hay. If conclusions could be based on the relation of the digestible nutrients in corn silage and alfalfa hay in ascertaining the relative values of these feeds, when alfalfa hay is worth $25.00 per ton, corn silage would be worth $8.62 per ton. However, the real value of any feed cannot be computed on the digestible nutrients alone. This is especially true of home grown feeds, such as corn silage. Many farmers do not realize that they are obtaining only about 45% of their corn crop when it is husked and the

stalks left in the field, while if the crop is put into the silo they conserve at least an additional 35%. No set valuation may be placed on corn silage that will apply to all sections and conditions, because of the variation in the cost of production, the percentage of the crop conserved, the ration that it supplements, the animal to which silage is fed, the natural laxative effect on the animal, and the economy of silage in the ration. Again, the tonnage yield per acre of corn for silage varies from eight to twelve tons throughout the Southwestern irrigated section, while the average yield of alfalfa in the same region is from two to four tons per acre. The economy of silage is emphasized in this instance, especially on high priced land. Alfalfa hay is considered a cash crop while corn fodder, corn stover, and silage are not usually considered as marketable.

EXPERIMENT No. 3

December 11, 1914, to May 7, 1915

BEET PULP vs. CORN SILAGE

The high price of grain in this section of the country necessitates a supplementary feed for dairy cows, if milk is to be produced economically. Therefore, the object of this experiment was to determine the relative feeding values of beet pulp and corn silage as a supplementary feed with grain and alfalfa hay, for milk production.

In order to make the proper comparison of the two feeds, ten cows were chosen from the College dairy herd and divided into two lots of five each. The cows were selected for the respective lots according to lactation periods, weights, and amount of milk produced by each during her preceding lactation period.

Lot No. 1 was made up of the following animals:

Penosa
Belle
Ruth
Coats
Helen

Lot No. 2 was made up of the following animals:

Olive
Rose
Moselle
Ada
Mabel

Penosa and Ada were purebred Jerseys, Moselle a purebred Holstein-Friesian, Rose a crossbred Guernsey-Shorthorn and the rest were grade Jerseys.

During the first thirty days of the experiment Lot 1 was given a grain ration composed of three parts ground wheat, two parts wheat bran and one part cotton-seed meal, at the rate of one pound of the grain mixture to five pounds of milk produced in a single day. Further, they received eight pounds of beet pulp per head and as much alfalfa hay as they would eat up clean.

Lot 2 was fed the same as Lot 1 during the first period, with the exception that beet pulp was replaced by corn silage.

The two lots were fed thirty days according to the above rations, when they were changed to the opposite ration; an intermission of ten days being given in order that the cows might adapt themselves to the change. Thus, the two lots were carried thru four periods alternating between dried beet pulp and corn silage, respectively; grain and hay remaining the same.

The four periods, of 30 days each, were as follows:
First Period, December 11, 1914, to January 9, 1915.
Second Period, January 19, 1915, to February 17, 1915.
Third Period, March 4, 1915, to April 2, 1915.
Fourth Period, April 8, 1915, to May 7, 1915.

TABLE XII.—FEED CONSUMED DURING EXPERIMENT 3.

First Period, December 11, 1914, to January 9, 1915 (30 days)

Lot 1				Lot 2			
Name of Cow	Grain	Beet Pulp	Alflafa Hay	Name of Cow	Grain	Corn Silage	Alfalfa Hay
	Pounds	Pounds	Pounds		Pounds	Pounds	Pounds
Penosa	233.5	240	...	Olive	90	833.5	...
Belle	113.5	240	...	Rose	150	900	...
Coats	120	240	...	Moselle	90	794.5	...
Ruth	60	240	...	Ada	113	874	...
Helen	150	240	...	Mabel	143.5	862.5	...
Totals...	677	1200	3049		586.5	4264.5	3353

Second Period, January 19 to February 17, 1915 (30 days)

		Silage				Beet Pulp	
Penosa	193	713	...	Olive	90	220.5	...
Belle	90	567	...	Rose	150	220.5	...
Coats	120	773	...	Moselle	73	59	...
Ruth	60	611	...	Ada	90	218	...
Helen	150	551.5	...	Mabel	137	221.5	...
Totals...	613	3233.5	3833		540	939.5	4157

Third Period, March 4 to April 2, 1915 (30 days)

		Beet Pulp				Silage	
Penosa	180	240	...	Olive	90	453.5	...
Belle	90	231	...	Rose	150	896.5	...
Coats	120	234.5	...	Moselle	60	594	...
Ruth	60	240	...	Ada	90	545	...
Helen	150	133.5	...	Mabel	148.5	660	...
Totals...	600	1079	4059		538.5	3149	3834

Fourth Period, April 8 to May 7, 1915 (30 days)

		Silage				Beet Pulp	
Penosa	180	859.5	...	Olive	90	234	...
Belle	90	623.5	...	Rose	157	240	...
Coats	120	730	...	Moselle	60	112	...
Ruth	60	662.5	...	Ada	90	234.5	...
Helen	150	681.5	...	Mabel	127	240	...
Totals...	600	3557	3464		524	1060.5	3749

Table XII shows the amount of grain, beet pulp, corn silage, and alfalfa hay consumed by each cow in each lot. It will be noted that there was considerable variation in the amounts of the different feeds eaten. This difference may be attributed to the fact that the grain was fed according to the number of pounds of milk produced by each cow and the amount of beet pulp eaten seemed to vary according to the appetite of the animal. Furthermore, during the first period and most of the second period the cows were given plain beet pulp, but due to the fact that this type of beet pulp was no longer obtainable without considerable delay, molasses beet pulp was substituted. This change did not appear to appeal to the cows, and they were averse to eating the molasses beet pulp for a time. The alfalfa hay fed during the first period was of poor quality, but during the remaining periods the cows received first-class hay and Table XII shows a material increase in the quantity of hay consumed. Further, the amount of feed eaten during the first period and most of the second period was not equal to the amount consumed later; which may be attributed partly to about ten days of inclement weather during the last of December and first of January.

TABLE XIII.—FEEDS CONSUMED AND MILK AND BUTTERFAT PRODUCED DURING EXPERIMENT 3.

Name of Cow	Grain	Silage	Beet Pulp	Alfalfa Hay	Milk	Av. Test	Butter-fat
Lot 1, Periods 1 and 3							
	Pounds	Pounds	Pounds	Pounds	Pounds	percent	Pounds
Penosa	413.5	...	480	...	1875.5	5.6	105.02
Belle	203.5	...	471	...	1036.5	4.85	50.27
Coats	240	...	474.5	...	1171.5	5.02	58.80
Ruth	120	...	480	...	581.5	5.1	29.65
Helen	300	...	373.5	...	1344	4.15	55.77
Totals	1277	...	2279	7234	6009	Av. 4.98	299.31
Lot 2, Periods 1 and 3							
Olive	180	1287	...	...	783.5	6.2	48.57
Rose	300	1796.5	...	...	1509	3.45	52.05
Moselle	150	1388.5	...	...	670	6.4	42.88
Ada	203	1419	...	...	816.5	5.3	43.27
Mabel	292	1522.5	...	...	1277.5	4.0	51.10
Totals	1125	7413.5	...	7061	5056.5	Av. 4.74	237.87
Lot 1, Periods 2 and 4							
Penosa	373	1590	...	...	1663.5	4.7	78.18
Belle	180	1190.5	...	...	644.5	4.8	30.93
Coats	240	1503	...	...	1140.5	5.5	62.72
Ruth	120	1273.5	...	...	493	4.7	23.17
Helen	300	1233	...	...	1282.5	3.85	49.37
Totals	1213	6790	...	6297	5224	Av. 4.67	244.37
Lot 2, Periods 2 and 4							
Olive	180	...	354.5	...	839.5	5.5	46.16
Rose	307	...	460.5	...	1645	3.45	56.75
Moselle	133	...	171	...	690	5.2	35.88
Ada	180	...	452.5	...	847	5.3	44.89
Mabel	264	...	461.5	...	1345	3.8	51.11
Totals	1064	...	2000	8907	5366.5	Av. 4.37	234.79

Table XIII gives a comparison of the relative value of beet pulp and corn silage, and the amount of milk and butterfat produced. The first two divisions of the table are arranged to compare Lots 1 and 2 during the first and third periods when Lot 1 had beet pulp and Lot 2 corn silage, then the other two divisions are arranged to compare the same lots when the beet pulp and corn silage are reversed; when Lot 1 had corn silage and Lot 2 had beet pulp. It will be noted that the lots receiving beet pulp produced a greater yield of milk and butterfat than those fed silage. Lot 1 was fed beet pulp in periods 1 and 3 and produced 785 pounds more milk and 55.14 pounds more butterfat than when fed silage in periods 2 and 4. Lot 2 was fed beet pulp to replace silage in periods 2 and 4 and produced 310 pounds more milk and 3.08 pounds less butterfat than when fed silage in periods 1 and 3.

TABLE XIV.—MILK AND BUTTERFAT PRODUCED.

First Period, December 11, 1914, to January 9, 1915 (30 days)

Lot 1

Name of Cow	Milk	Test	Butterfat	Kind of Roughage
	Pounds	Per Cent	Pounds	
Penosa	1054	6.0	63.24	Beet Pulp
Belle	498	5.3	26.39	"
Coats	579.5	5.7	33.03	"
Ruth	273.5	5.8	15.86	"
Helen	692.5	4.4	30.47	"
Totals	3061.5	Avg. 5.51	168.99	1200 lbs.

Lot 2

Olive	394.5	6.8	26.82	Silage
Rose	700.5	3.9	27.31	"
Moselle	337	6.6	22.24	"
Ada	413.5	6.0	24.81	"
Mabel	679.5	4.2	28.53	"
Totals	2525	Avg.5.12	129.71	4264.6

Second Period, January 19 to February 17, 1915 (30 days)

Lot 1

Penosa	895	4.0	35.80	Silage
Belle	480	5.2	24.96	"
Coats	611	5.4	32.99	"
Ruth	267	4.2	11.21	"
Helen	634.5	4.0	25.38	"
Totals	2887.5	Avg.4.51	130.34	3233.5 lbs.

Lot 2

Olive	456	5.0	22.82	Beet Pulp
Rose	799	3.3	26.36	"
Moselle	331.5	5.2	17.23	"
Ada	414	5.2	21.52	"
Mabel	691	3.8	26.25	"
Totals	2691.5	Avg.4.13	114.18	939.5 lbs.

Third Period, March 4 to April 2, 1915 (30 days)

Lot 1

Penosa	821.5	5.2	42.71	Beet Pulp
Belle	538.5	4.4	23.69	"
Coats	592	4.4	26.04	"
Ruth	308	4.4	13.55	"
Helen	651.5	3.9	25.40	"
Totals	2911.5	Avg.4.51	131.39	1068

Lot 2

Olive	389	5.6	21.78	Silage
Rose	808.5	3.0	24.25	"
Moselle	333	6.2	20.64	"
Ada	403	4.6	18.53	"
Mabel	598	3.8	22.72	"
Totals	2531.5	Avg.4.22	107.92	3149 lbs.

Fourth Period, April 8 to May 7, 1915 (30 days)
Lot 1

Name of Cow	Milk	Test	Butterfat	Kind of Roughage
	Pounds	Per Cent	Pounds	
Penosa	768.5	5.4	41.79	Silage
Belle	164.5	4.4	7.23	"
Coats	529.5	5.6	29.65	"
Ruth	226	5.2	11.75	"
Helen	648	3.9	25.27	"
Totals	2336.5	Avg.4.95	115.69	3557 lbs.

Lot 2

Name of Cow	Milk	Test	Butterfat	Kind of Roughage
Olive	383	6.0	22.98	Beet Pulp
Rose	846	3.6	30.45	"
Moselle	358.5	5.2	18.64	"
Ada	433	5.4	23.38	"
Mabel	654	3.8	24.85	"
Totals	2674.5	Avg.4.49	120.30	1060.5 lbs.

Table XIV shows the number of pounds of milk and butterfat produced by each lot by periods when fed beet pulp and corn silage, respectively. The records show that Lot 1 produced a greater amount of milk and butterfat when fed beet pulp by alternating periods than was produced when fed silage in the same manner. Lot 2 showed an increase in the amount of milk but a very slight decrease in butterfat when fed beet pulp to replace silage. Each lot evidenced a slight variation in the per cent of fat in the milk, but this small difference could not justly be attributed to the character or kind of roughage eaten with alfalfa hay as a supplement. The most noticeable variations were during the first two periods and were probably due to weather conditions, as it was during this time that the coldest and most undesirable weather was experienced.

Table XV.—Weights According to Lots and Feeds Eaten.

Lot 1

Name of Cow	Period 1. Fed grain, beet pulp, and alfalfa hay			Period 2. Fed grain, corn silage, and alfalfa hay		
	Dec. 11 1914 (average)	Jan. 9 1915 (average)	Gain or Loss	Jan. 19 1915 (average)	Feb. 18 1915 (average)	Gain or Loss
	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
Penosa	1220	1225	+5	1227	1250	+23
Belle	807	787	−20	818	805	−13
Ruth	853	860	+ 7	865	900	+35
Coats	1216	1250	+34	1253	1265	+12
Helen	823	825	+ 2	830	810	−20
Totals	4919	4947	+28	4993	5030	+37

Lot 2

	Period 1. Fed grain, corn silage, and alfalfa hay			Period 2. Fed grain, beet pulp, and alfalfa hay		
Olive	753	745	− 8	763	760	− 3
Rose	993	997	+ 4	1010	1030	+20
Moselle	1216	1230	+14	1270	1255	−15
Ada	890	895	+ 5	910	945	+35
Mabel	950	955	+ 5	980	997	+17
Totals	4802	4822	+20	4933	4987	+54

Lot 1

	Period 3. Fed grain, beet pulp, and alfalfa hay			Period 4. Fed grain, corn silage, and alfalfa hay		
	Mar. 4 1915 (average)	Apr. 2 1915 (average)		Apr. 8 1915 (average)	May 7 1915 (average)	
Penosa	1233	1206	−27	1258	1257	− 1
Belle	807	800	− 7	826	870	+44
Ruth	887	863	−24	913	944	+31
Coats	1273	1252	−21	1290	1317	+27
Helen	843	820	−23	838	863	+25
Totals	5043	4941	−102	5125	5251	+126

Lot 2

	Period 3. Fed grain, corn silage, and alfalfa hay			Period 4. Fed grain, beet pulp, and alfalfa hay		
Olive	773	757	−16	763	817	+54
Rose	1037	1042	+ 5	1062	1100	+38
Moselle	1213	1198	−15	1208	1190	−18
Ada	913	910	− 3	933	960	+27
Mabel	987	993	+ 6	1003	1030	+27
Totals	4923	4900	−23	4969	5097	+128

Table XV gives the average weight of each animal in both Lot 1 and Lot 2 during the periods they were fed alternately beet pulp and corn silage. The table shows that each lot gained in weight during the first and second periods of the experiment. When fed beet pulp to replace silage, Lot 1 gained 28 pounds, and when corn silage was substituted for beet pulp a gain of 33 pounds was obtained. Lot 2 gained 20 pounds on silage and 54 pounds on beet pulp. During the third period Lot 1 was fed beet pulp and lost 102 pounds in weight, while during the fourth period on silage Lot 1 gained 126 pounds. This wide variation in weight may have been due to the physical condition of Lot 1 during the third and fourth periods. Lot 2 lost 23 pounds when fed silage in the third period and gained 128 pounds when fed beet pulp in the fourth period. The difference in weight, with the exception of Lot 1 in the third period, was very small and may have been due to a large amount of water or undigested food in the digestive tract.

TABLE XVI.—TOTAL FEED CONSUMED BY EACH COW AND EACH LOT DURING THE FOUR PERIODS (120 days).

Lot 1

Name of Cow	Grain	Beet Pulp	Corn Silage	Alfalfa Hay	
	Pounds	Pounds	Pounds	Pounds	
Penosa	786.5	480	1590		
Belle	383.5	471	1190.5	3175	(Lot 1, first period)
Coats	480	474.5	1503	2833	(Lot 1, second period)
Ruth	240	480	1273.5	4059	(Lot 1, third period)
Helen	600	373.5	1233	3464	(Lot 1, fourth period)
Totals	2490	2279	6790	13531,	or 22.55 lbs. per cow per day

Lot 2

Name of Cow	Grain	Beet Pulp	Corn Silage	Alfalfa Hay	
Olive	360	454.5	1287		
Rose	607	460.5	1796.5	3227	(Lot 2, first period)
Moselle	283	171	1388.5	5158	(Lot 2, second period)
Ada	383	452.5	1419	3834	(Lot 2, third period)
Mabel	556	461.5	1522.5	3749	(Lot 2, fourth period)
Totals	2189	2000	7413.5	15968,	or 26.61 lbs. per cow per day

In Table XVI the total grain, beet pulp, corn silage, and alfalfa hay consumed by each animal is shown for all four periods. Careful records were kept of all feed eaten by each cow, with the exception of alfalfa hay. In feeding the hay the number of pounds fed and consumed by each lot was carefully kept on record and any refuse left in the feed racks deducted; therefore, the amount consumed by each cow

was not definitely known and the average amount consumed was taken as a basis for comparison. Lot 1 consumed 13531 pounds of alfalfa, or an average of 22.55 pounds per cow per day; Lot 2 consumed 15968 pounds, an average consumption of 26.61 pounds per cow per day. Lot 1 consumed 300.5 pounds of grain and 279 pounds of beet pulp in excess of the amount of grain and beet pulp consumed by Lot 2; while Lot 2 utilized 423.5 pounds of silage and 2437 pounds of alfalfa hay in excess of the amount eaten by Lot 1.

Table XVII.—Showing Costs of Feeds Consumed and Feed Cost of Milk and Butterfat Produced.

Name of Cow	Grain, @ $30.00 a ton	Beet Pulp, @ $30.00 a ton	Alfalfa Hay, @ $10.00 a ton	Total	Feed Cost per cwt. of Milk	Feed Cost per lb. of Butterfat
		Lot 1, Periods 1 and 3				
Penosa	$ 6.20	$ 7.20	$ 7.23	$20.63	$ 1.09	$ .19
Belle	3.05	7.06	7.23	17.34	1.67	.34
Coats	3.60	7.11	7.23	17.94	1.53	.39
Ruth	1.80	7.20	7.23	16.23	2.81	.55
Helen	4.50	5.60	7.23	17.33	1.29	.31
		Lot 2, Periods 2 and 4				
Olive	2.70	6.81	8.90	18.41	2.19	.39
Rose	4.60	6.90	8.90	20.40	1.24	.35
Moselle	1.99	2.56	8.90	13.45	1.94	.37
Ada	2.70	6.78	8.90	18.30	2.16	.40
Mabel	3.96	6.92	8.90	19.78	1.47	.38
		Corn Silage @ $3.50 a ton				
		Lot 1, Periods 2 and 4				
Penosa	5.59	2.78	6.30	14.67	.88	.187
Belle	2.70	2.08	6.30	11.08	1.71	.34
Coats	3.60	2.63	6.30	12.53	1.09	.20
Ruth	1.80	2.22	6.30	10.32	2.09	.44
Helen	4.50	2.15	6.30	12.95	1.00	.25
		Lot 2, Periods 1 and 3				
Olive	2.70	2.25	7.05	12.00	1.53	.24
Rose	4.50	3.14	7.05	14.69	.97	.28
Moselle	2.25	2.43	7.05	11.73	1.75	.27
Ada	3.04	2.48	7.05	12.57	1.53	.29
Mabel	4.38	2.66	7.05	14.09	1.10	.27

As explained on page 34, an accurate record was kept of the feeds consumed by each lot, but record was not made of the alfalfa hay eaten by each cow. Therefore, the figures in the last four columns of the above table are merely close approximations. The grain mixture used consisted of 3 parts ground wheat, 2 parts wheat bran and 1 part cottonseed meal, by weight.

The prices used in the accompanying data, Table XVII, are based on market prices of the respective feeds at the time the experiment was conducted. Grain at $30.00 per ton is a very low figure for the same grain at the present time. In fact, the prices of feed as given in Table XVIII are all too low for present market conditions.

It will be noted that Lot 1 produced milk at a lower cost per hundredweight when fed silage in periods 2 and 4 than when fed beet pulp in periods 1 and 3. The same uniform results were obtained with Lot 2. This difference was due to the fact that the silage consumed, while greater in amount, was charged the cows at a much lower price. Further, the total cost of feed was lowered by replacing beet pulp with silage; consequently a lower cost per pound of butterfat produced. These data are interesting and should prove an important source of information to dairymen and farmers of this section of the country.

TABLE XVIII.—GENERAL RESULTS, EXPERIMENT 3.

Beet Pulp and Alfalfa Hay with Grain	Lot 1 periods 1 and 3		Lot 2 periods 2 and 4	
	Pounds	Cost	Pounds	Cost
Grain mixture consumed	1277	$19.15	1064	$15.96
Dried beet pulp consumed	2279	34.18	2000	30.00
Alfalfa hay consumed	7108	35.54	7906	39.53
Average grain consumed per cow per day	4.25	.064	3.54	.053
Average beet pulp consumed per cow per day	7.59	.114	6.66	.100
Average alfalfa hay consumed per cow per day	23.69	.118	26.35	.131
Butterfat prouced by beet pulp and hay with grain	6009	88.87	5366.5	85.49
Milk produced by beet pulp and hay with grain	299.51	......	234.79	......
Cost per hundredweight of milk	......	1.478	......	1.593
Cost per pound of butterfat	......	.296	......	.364

Corn Silage and Alfalfa Hay with Grain	Lot 1 periods 2 and 4		Lot 2 periods 1 and 3	
Grain mixture consumed	1213	$18.19	1125	$16.87
Corn silage consumed	6790	11.88	7413	12.97
Alfalfa hay consumed	7297	36.48	7187	35.93
Average grain consumed per cow per day	4.04	.06	3.75	.056
Average corn silage consumed per cow per day	22.63	.039	24.71	.043
Average alfalfa hay consumed per cow per day	24.32	.141	23.95	.119
Milk produced by corn silage and hay with grain	5224	66.55	5056.5	65.77
Butterfat produced by corn silage and hay with grain	244.37	......	237.87	......
Cost per hundredweight of milk	......	1.273	......	1.300
Cost per pound of butterfat	......	.272	......	.276

Final Results, both lots				
Total milk produced by beet pulp and hay with grain	11375.5	......	......	......
Total butterfat produced by beet pulp and hay with grain	534.30	......	......	......
Cost per hundredweight of milk	......	$ 1.532	......	......
Cost per pound of butterfat	......	.326	......	......
Total milk produced by silage and hay with grain	10280.5	......	......	......
Total butterfat produced by silage and hay with grain	482.24	......	......	......
Cost per hundredweight of milk	......	1.287	......	......
Cost per pound of butterfat	......	.274	.....	......
Excess of milk produced by beet pulp and hay with grain	1095	......	......	......
Excess of butterfat produced by beet pulp and hay with grain	52.06	......	......	......
Excess of cost per hundredweight of milk produced by beet pulp and alfalfa hay with grain	......	.245	......	......
Excess of cost per pound of butterfat produced by beet pulp and hay with grain	......	.052	......	......

Table XVIII gives a summary of results separately for the periods when beet pulp was fed and for those when the pulp was replaced by corn silage. It also shows the total production of milk and butterfat by each ration, and the cost of the same per unit.

Lot 1 produced 785 pounds more milk during the two periods that it was given beet pulp than during the two it received corn silage, and Lot 2, 310 pounds more, favorable to the beet pulp; but the cost of production was 20 cents more per hundredweight when beet pulp was fed to Lot 1 and 29.3 cents more when fed to Lot 2.

Beet pulp apparently favorably influenced both the quantity of milk and butterfat but its cost, on account of the long distance from the sugar factories, makes its feeding almost prohibitive where silage crops can be as cheaply grown and stored as in this locality.

SUMMARY

BEET PULP vs. CORN SILAGE

The object of this experiment was to determine the relative value of dried beet pulp and corn silage as supplementary feeds for dairy cows, and their relation to milk production, but it is also necessary to compare the expense accounts incurred, as shown by the data incorporated in the foregoing tables.

1. It is evident from Table XVIII that both the quantity and the cost of milk produced were increased by feeding beet pulp to replace corn silage. The milk produced by Lot 1 when fed beet pulp to replace corn silage was increased 15 per cent, at an additional cost of $22.32. Lot 2 produced 6.13 per cent more milk when fed beet pulp to replace silage, with an increased cost of production of $19.72, making an average increased production of 10.65% when beet pulp was fed in place of corn silage, with an additional cost of $42.04.

The increased cost per hundredweight of milk produced by feeding beet pulp to replace corn silage was as follows: Lot 1, 31 cents, and Lot 2, 39.7 cents, respectively, giving an average increase of 33.3 cents per hundredweight.

Lot 1 when fed beet pulp produced 55.14 pounds of butterfat in excess of that produced when fed corn silage, while the amount of butterfat produced by Lot 2 was 3.08 pounds in favor of corn silage over beet pulp; the combined result being 52.06 pounds in favor of the beet pulp.

Obviously, the cost per pound of butterfat produced would be increased by feeding beet pulp to replace corn silage, under conditions

similar to those that prevailed in this experiment. The cost per pound of butterfat was increased 2.4 cents with Lot 1 and 8.8 cents with Lot 2, an average of both lots being 5.6 cents.

2. Basing the comparison of beet pulp and corn silage on the total cost of the feed consumed by both lots, there was an increase of 1095 pounds of milk and 58.22 pounds of butterfat produced in favor of beet pulp, at an advance in the total cost of $42.04. Beet pulp increased the total cost of milk per hundredweight 33.3 cents and the butterfat, 5.6 cents a pound.

3. The total amount of silage eaten by both lots (Table XVI) was 14203 pounds and the amount of milk produced by both lots when fed silage was 10280.5 pounds (Table XVIII). From the same tables, the total amount of beet pulp consumed by both lots was 4279 pounds and the total milk produced when beet pulp replaced silage was 11375.5 pounds; the beet pulp having increased the amount of milk 1095 pounds. Consequently, 1 pound of beet pulp replaced 3.64 pounds of corn silage (14203:10208.5::4279:11375 = 3.64).

4. Basing the comparisons upon recent analyses of corn silage and beet pulp, 3.64 pounds of silage contain .957 pound of dry matter, and one pound of beet pulp contains .918 pound of dry matter. Therefore, it would require 100 pounds of dry matter in silage to replace 95.9 pounds of dry matter in beet pulp ($.918 \div .957 \times 100 = 95.9$).

5. The total per cent of digestible nutrients in corn silage is 17.7 and in beet pulp 73.5. Since 1 pound of beet pulp replaces 3.64 pounds of silage which contains .644 pound of digestible nutrients, it would, therefore, require 100 pounds of digestible nutrients of beet pulp to replace the 87.6 pounds of the digestible nutrients of the corn silage.

6. Referring again to recent analyses, corn silage has 17.7 pounds of digestible nutrients per hundred pounds, or 354 pounds in one ton; beet pulp has 1470 pounds per ton. Therefore, the cost of 100 pounds of digestible nutrients in corn silage was $0.988 and in beet pulp $2.04. Considering that it requires 3.64 pounds of silage to replace 1 pound of beet pulp as the accompanying data show, 364 pounds of silage, on a digestible nutrient basis, would cost $3.56; while the digestible nutrients in 100 pounds of beet pulp would cost $2.04. Computing the cost of 100 pounds of digestible nutrients in corn silage, based on silage at $5.00 per ton and beet pulp remaining at $30.00 per ton, 100 pounds of digestible nutrients in silage would cost

$1.41, or 364 pounds would cost $5.13; and 100 pounds of digestible nutrients in beet pulp would cost $2.04, as above stated.

7. It was shown in Table XVIII that the beet pulp produced 1095 pounds more milk than did corn silage. In order to ascertain whether this excess of milk was produced at a profit or a loss, the additional cost being $53.13, it was found that if this milk had been separated, the cream testing 30 per cent, and butterfat estimated at 30 cents per pound with skimmilk at 30 cents per hundredweight, it would have been worth $18.36, still leaving a deficit of $34.77; corn silage being taken as a standard. Considering the 1095 pounds of whole milk worth $2.00 per hundredweight on the market it would have brought the producer $21.90. Even this proposition shows a loss of $31.23, taking silage as a standard. Further, if the 1095 pounds of whole milk had been marketed on a quart basis at 10 cents per quart (market price for this section during the experiment) it would have been worth $50.93; leaving a loss of $2.20. Therefore, basing conclusions on the above data, the excess milk produced by feeding beet pulp to replace corn silage in this experiment was produced at a loss. The beet pulp, while producing more milk than silage, did not prove an economical feed.

8. Basing conclusions on the results as shown by this experiment, it should prove more economical for the average farmer of this State to feed corn silage to dairy cattle than to attempt to replace this succulent portion of the ration by dried beet pulp.

9. Table XV shows the effect of both corn silage and beet pulp on the average weights of each animal in each lot during the experiment. By careful reference to this table it will be noted that the average weight of each lot during the four periods shows a very slight variation. In fact, the difference is so slight as to be within the limits of error, and neither feed shows any material advantage over the other in regard to a gain or a loss in weight.

10. In conclusion, the fact should not be overlooked that excellent silage crops are being produced in many of the leading agricultural sections of this State, and considering silage worth from $3.50 to $5.00 per ton in the silo, it should be more economical as a supplement in the dairy ration than beet pulp at the average price of $30.00 per ton. Farmers located in close proximity to beet sugar factories will, of course, be in position to obtain high-class fresh beet pulp at a very reasonable cost, and can often make profitable use of it.

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Agricultural Experiment Station
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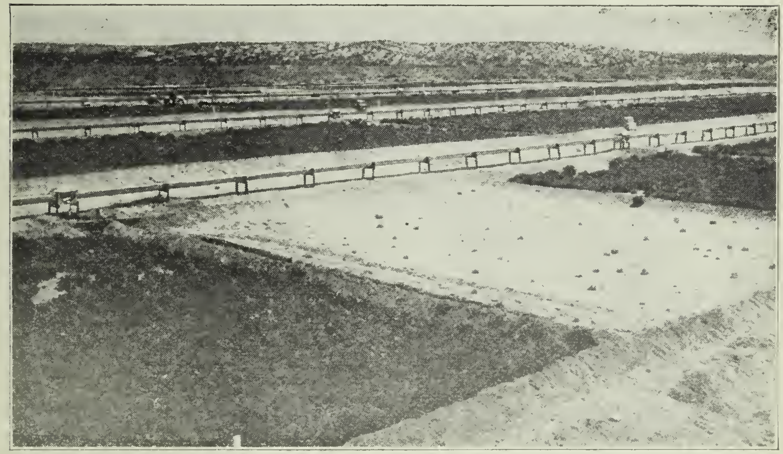

EXPERIMENTAL ALFALFA AND FALLOW PLATS ON BENCH OR MESA LAND

SOIL MOISTURE MOVEMENT IN RELATION TO GROWTH OF ALFALFA

BY

C. A. THOMPSON AND E. L. BARROWS

Rio Grande Republic, Las Cruces, N. M.

New Mexico Agricultural Experiment Station

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*In cooperation with the Office of Public Roads and Rural Engineering, U. S. Department of Agriculture.

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SOIL MOISTURE MOVEMENT IN RELATION TO GROWTH OF ALFALFA

The greater part of the irrigated agricultural area of New Mexico consists of valley land. In many places adjacent to the valleys are large areas of table land locally known as mesa. Much of this land is suitable for cultivation if water were available. In view of the fact that little has been known of the physical properties of this type of soil, the purposes of this experiment were to study the movement and distribution of soil moisture in connection with depth of application of irrigation water and the cultural treatment of the soil. The project has also included a study of the soil moisture and duty of water in relation to the crop.

The results of the preliminary work under this project were published in Bulletin No. 93, under the title of "Soil Physics and Soil Moisture in Relation to First Year's Growth of Alfalfa."

THE SOIL

The soil may be classed as a sandy loam. The material giving rise to this type of soil was brought down during torrential rains from the higher lying mesa and upland plains and deposited over the lower margin of the mesa slopes. It is open and friable and easily tilled, and is quite uniform to a depth of six feet, except where pockets of gravel and coarse sand appear. These, however, are not extensive; but where they exist they have considerable influence on the water holding capacity and other physical factors of the soil.

IRRIGATION SYSTEM

The water for irrigation is obtained from a twelve-inch drilled well by a five-inch two-stage vertical centrifugal pump driven by a thirty-five horsepower electric motor. The pump is at the bottom of an eight-foot concrete lined pit, seventy feet deep, and works under a head of eighty-five feet.

The water is conducted through an eight-inch slip joint pipe to the weir house at the corner of the field containing the experimental plats. Measurements are made over a one-foot Cippoletti weir, the gage being so constructed as to read directly in cubic feet per minute.

Owing to the steep slope of the land it was found necessary

to lay out four terraces, each terrace containing twelve plats 47 feet by 50 feet, or slightly less than one-eighteenth of an acre each. The plats in each row or terrace are supplied with water from a corrugated iron flume with sheet iron check and outlet boxes. Each box serves two plats.

After the water is measured at the weir it flows through a 12-inch vitrified clay pipe line through four concrete distribution boxes, one for each flume.

PLAN OF EXPERIMENT

In order to secure more uniformity of results the plats were divided into four series, based on the depth of soil down to a pocket or seam of coarse material. The soil is, in general, uniform to the depths indicated in Fig. 1, but in some cases small pockets of coarse material occur nearer the surface.

Each series consists of twelve plats, eight of which support a crop, two a cultivated crop, and two were left fallow. In each series different plats were flooded to a depth of two, three, four, and five inches, respectively, at each irrigation. It was hoped that the results of this method of irrigation would show a relationship between the depth of soil, the amount of water used, and the crop produced.

Hilgard (1) has stated that in general plants make their best growth when soils contain from 40 to 60 per cent of their maximum water holding capacity. It has been determined that the maximum water holding capacity for this type of soil, by the Hilgard method, is about 22 per cent. According to these figures the moisture content of this soil should be maintained somewhere between 9 per cent and 13 per cent for optimum growth. According to Professor J. D. Tinsley (2), who started this series of experiments, plants on this soil do not generally suffer when the average moisture content of the first six feet is allowed to fall to 7 per cent.

This figure of 7 per cent was, then, arbitrarily adopted as the standard of minimum soil moisture. Samples were taken for moisture determination at ten-day intervals. At the beginning of the season and after each cutting, all plats were irrigated, regardless of moisture content. At the intervening irrigations which were at 10-day intervals, only those plats were irrigated in which the average moisture content of the first six feet fell to 7 per cent as shown by the moisture determination.

48 5' I CC	47 4" IV CC	46 4" III F	45 5 I F	44 2 II C	43 3 III CF	42 5 II C	41 4 II C	40 3" IV C	39 3" III C	38 4 IV F	37 4' IV C
25 2 III C	26 3" II C	27 4" III CC	28 5" IV C	29 2 I C	30 3' I CC	31 4" III C	32 3 III C	33 2" IV C	34 5" III C	35 2" II C	36 3" IV CF
24 3 I C	23 4 II C	22 4' I C	21 5 I C	20 4 I C	19 3 I CC	18 3 III C	17 5 IV C	16 2' III C	15 3 IV CC	14 4 II CC	13 3 II F
1 4" III C	2 2 I C	3 5 I CF	4 5 I C	5 3 II C	6 [illegible] II CC	7 5 II C	8 3" II CF	9 4 IV C	10 3 IV C	11 2 IV C	12 5 III C

I SOIL SERIES I 6 OR MORE FEET OF SOIL OVER GRAVEL
II SOIL SERIES II 4 TO 5 FEET OF SOIL OVER GRAVEL
III SOIL SERIES III 2 TO 4 FEET OF SOIL OVER GRAVEL
IV SOIL SERIES IV - 2 FEET OF SOIL OVER GRAVEL
C PLATS SUPPORTING A CROP
CC PLATS SUPPORTING A CULTIVATED CROP
F FALLOW PLATS
CF CULTIVATED FALLOW PLATS

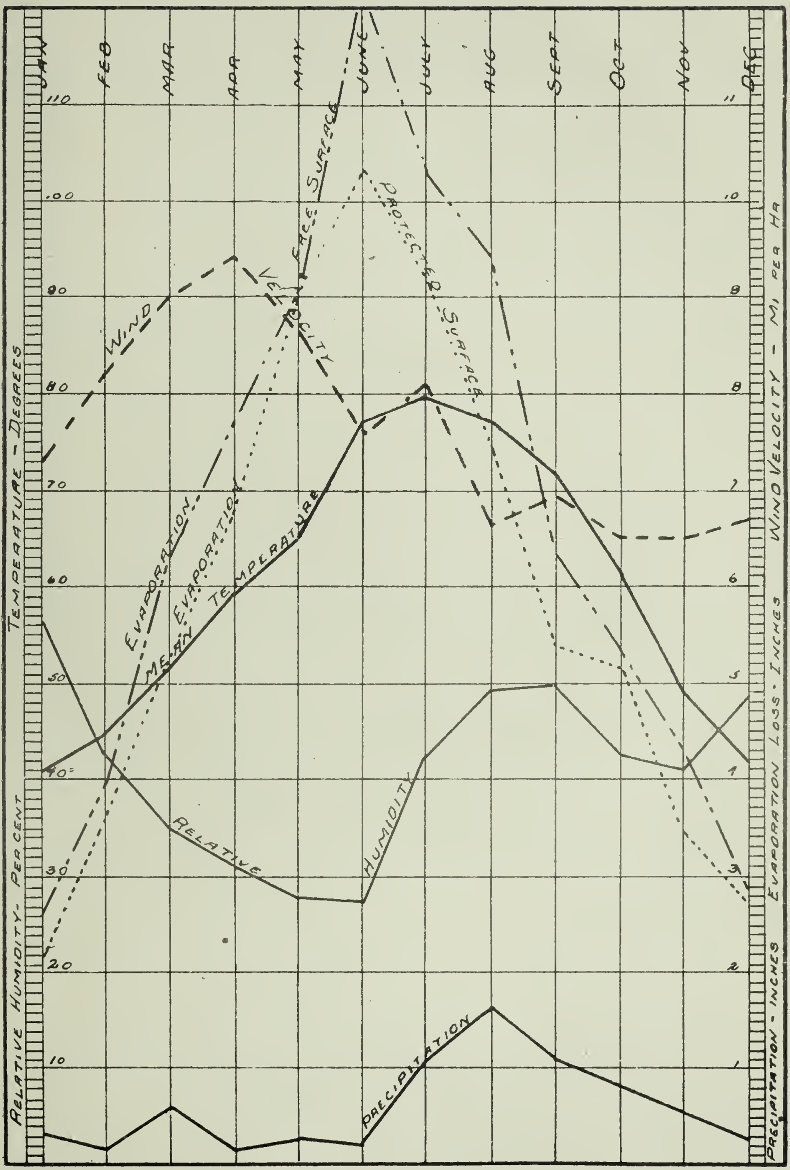
TABLE I.—PRECIPITATION BY MONTHS FOR THE FIVE-YEAR PERIOD ENDING DECEMBER 31, 1919.

Month	1915	1916	1917	1918	1919	Average
	Inches	Inches	Inches	Inches	Inches	Inches
January	0.64	0.25	0.19	0.41	0.10	0.32
February	0.59	0.18	T	0.08	T	0.17
March	1.23	0.67	0.01	T	1.31	0.64
April	0.11	0.07	0.01	T	0.46	0.13
May	0	0.97	0.34	0.05	0.05	0.28
June	T	0	T	0.69	0.29	0.20
July	1.24	0.50	1.31	1.02	1.21	1.06
August	1.32	1.28	3.09	1.64	0.90	1.65
September	2.11	0.69	0.51	0.05	2.09	1.09
October	0.01	2.50	T	0.98	0.61	0.82
November	T	0.52	0.12	1.43	0.78	0.57
December	0.12	0.15	T	0.88	0.25	0.28
Total	7.37	7.78	5.58	7.23	8.05	7.21

The normal annual precipitation as determined for a period of fifty-eight years is 8.59 inches for this section. The early part of the year and especially during the early growing season the rainfall is scant, there frequently being two months without more than a trace of rain. The rainy season usually begins in July and continues through August. During these two months there are, as a rule, considerable cloudy weather and a number of rainy days, although the total precipitation for any month is not very great. The annual precipitation during the five-year period is a little below normal, and shows the absolute necessity of irrigation, the precipitation being sufficient only for some of the drouth resistant desert plants.

EVAPORATION

The evaporation greatly exceeds the precipitation, the annual evaporation from a free water surface being nearly ten times as great as the normal annual precipitation.


JAN
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TEMPERATURE - DEGREES
RELATIVE HUMIDITY - PER CENT
WIND VELOCITY - MI PER HR
EVAPORATION LOSS - INCHES
PRECIPITATION - INCHES
WIND VELOCITY
EVAPORATION
FREE SURFACE
EVAPORATION
PROTECTED SURFACE
MEAN TEMPERATURE
RELATIVE HUMIDITY
PRECIPITATION

TABLE II.—EVAPORATION BY MONTHS FOR THE FIVE-YEAR PERIOD ENDING DECEMBER 31, 1919.

Month	1915	1916	1917	1918	1919	Average
	Free Water Surface					
	Inches	Inches	Inches	Inches	Inches	Inches
January	2.91	2.63	1.94	2.30	2.62	2.48
February	2.97	3.18	3.88	4.09	3.98	3.62
March	4.24	6.42	6.13	7.00	6.31	6.02
April	7.23	7.16	8.76	8.60	7.71	7.89
May	8.75	9.37	10.28	8.47	9.02	9.18
June	10.22	12.63	13.09	11.77	12.19	11.98
July	11.71	10.74	11.68	10.43	10.26	10.96
August	7.91	9.16	8.08	8.53	9.40	8.62
September	5.25	7.44	7.39	8.87	6.33	7.06
October	4.82	5.62	6.50	6.71	5.35	5.80
November	4.93	4.16	4.37	3.50	4.30	4.25
December	2.23	2.52	2.12	1.38	2.87	2.22
Total	73.17	81.03	84.22	81.65	80.34	80.08
	Protected Surface					
January	1.64	2.32	1.82	2.43	2.19	2.08
February	2.46	3.61	3.35	3.81	3.58	3.36
March	3.94	6.04	5.78	6.25	5.21	5.44
April	5.69	6.67	8.13	7.35	6.71	6.91
May	5.88	9.37	9.36	7.58	9.02	8.24
June	9.13	10.37	11.53	10.60	10.32	10.39
July	9.22	10.00	10.49	9.97	9.19	9.77
August	6.49	8.03	7.22	7.93	7.45	7.42
September	4.75	7.07	6.51	8.05	5.41	6.36
October	4.88	4.87	6.00	5.47	5.12	5.27
November	3.87	3.40	3.74	3.16	3.44	3.52
December	2.48	3.02	2.25	1.25	2.72	2.34
Total	60.43	74.77	76.18	73.85	70.36	71.11

Table II shows a comparison of the evaporaton from water surface for five years. The protected surface was surrounded by a glass wall 29 inches in height; the object being to protect the surface from the increased evaporating effects of the wind. The monthly evaporation from the protected surface is from 6 to 12 inches less than from the free surface. While the evaporation varies during the different years, the averages for the protected and free water surfaces for the five-year period were 71.11 and 80.08 inches, respectively.

TEMPERATURE, HUMIDITY, AND WIND VELOCITY

Among the factors affecting the loss of water—both by evaporation and transpiration—temperature, humidity, and wind are perhaps the most important. High temperatures are usually accompanied by low relative humidities. These two factors, combined with a comparatively high wind velocity, furnish an explanation for the high evaporation during the spring and summer months, which in turn has a marked effect upon the amount of irrigation water needed during this period.

TABLE III.—MEAN TEMPERATURE AND RELATIVE HUMIDITY BY MONTHS FOR FIVE-YEAR PERIOD, ENDING DECEMBER 31, 1919.

Month	1915	1916	1917	1918	1919	Average
	Monthly Mean Temperature					
	°F.	°F.	°F.	°F.	°F.	°F.
January	39.0	47.1	42.0	38.0	37.7	40.8
February	45.6	49.9	44.4	47.8	36.3	44.8
March	47.8	56.8	48.9	53.8	50.8	51.6
April	58.9	59.6	57.8	59.0	61.0	59.3
May	63.4	66.7	61.8	64.7	67.2	64.8
June	76.8	77.8	75.4	79.5	75.0	76.9
July	80.1	79.6	81.6	76.9	78.5	79.3
August	75.6	77.1	77.2	76.4	78.7	77.0
September	71.2	70.8	71.0	71.5	70.8	71.1
October	60.8	61.7	60.0	61.2	61.1	61.0
November	48.9	46.8	50.6	46.8	49.2	48.5
December	41.0	40.0	44.8	38.2	44.2	41.6
Average	59.1	61.2	59.6	59.5	59.2	59.7
	Mean Relative Humidity					
	Per Cent	Per Cent	Per Cent	Per Cent	Per Cent	Per Cent
January	63.2	54.9	56.7	54.3	51.7	56.2
February	52.9	37.5	42.0	36.0	44.7	42.6
March	54.2	30.1	21.0	31.8	38.0	35.0
April	44.8	31.4	18.9	21.2	38.9	31.0
May	28.6	25.2	25.6	23.9	36.4	27.9
June	25.6	17.8	21.5	35.6	36.0	27.3
July	45.2	37.7	37.8	41.8	50.1	42.5
August	50.7	51.4	47.4	48.2	48.1	49.2
September	55.4	43.4	46.8	44.1	58.8	49.7
October	37.3	43.6	28.8	44.7	58.5	42.6
November	27.0	40.3	30.3	52.4	55.5	41.1
December	54.0	40.6	28.3	65.0	53.0	48.2
Average	44.9	37.8	33.8	41.6	47.5	41.1

Temperature aside from affecting evaporation also affects or, in fact, largely controls, crop growth. The usual growing season for alfalfa is from March 15 to October 15. During the early part of the growing season, when the nights are cool, alfalfa grows rather slowly and eight or ten weeks are usually required for the first cutting. After this the temperature is higher and a crop may be cut every 30 days, until the last cutting, which is usually given a little longer time. During 1916, six cuttings of alfalfa were secured and for the other four years five cuttings were made annually.

It will be noticed from Table III that there is not very much difference in the mean temperature during the same month for the five-year period, but that there is considerable difference in relative humidity for the same month in different years. For example, during March and April for 1917 and 1918 the relative humidity is much lower than during the other years. March, April, May, and June are usually the months having the lowest relative humidity.

TABLE IV.—AVERAGE WIND VELOCITY BY MONTHS FOR FIVE-YEAR PERIOD ENDING DECEMBER 31, 1919.

(Miles per hour)

Month	1915	1916	1917	1918	1919	Average
January	6.9	8.3	6.4	7.6	7.1	7.3
February	7.3	7.3	7.7	9.6	9.1	8.2
March	8.2	9.7	8.2	9.4	9.5	9.0
April	9.5	8.6	8.7	12.3	8.1	9.4
May	8.1	8.3	11.2	8.3	7.2	8.6
June	8.0	7.6	8.4	7.3	6.7	7.6
July	7.4	9.5	8.2	7.5	7.9	8.1
August	6.8	6.9	6.2	6.8	6.4	6.6
September	7.5	7.4	6.4	7.0	6.1	6.9
October	5.9	7.7	6.8	6.3	6.0	6.5
November	6.7	5.1	5.9	7.3	7.5	6.5
December	6.4	6.5	5.1	8.0	7.6	6.7
Average	7.39	7.74	7.43	8.12	7.43	7.62

The wind velocity shown in Table IV is the wind movement recorded by an anemometer located on the roof of Science Hall, about 200 yards from the plats. This is the velocity at considerable height above the ground, and is, therefore, much greater than it would be at the surface of the ground. The average hourly wind velocity is greatest during the months of March, April, and May. During this period high winds are common, frequently reaching a velocity of forty to fifty miles an hour, and continuing at a high rate for a number of hours at a time. During the rest of the year high winds are not usually so common, but may occur at any time.

Experimental Data

Length of Alfalfa Roots

Just previous to the irrigation season, the lengths of the roots in different plats were determined. The roots were secured by digging a hole on the side of the plat and carefully taking out the roots. Several plants from each plat were secured in this manner, and the average of the length of these roots taken. Plats were selected for this purpose which had as wide a range in the amount of irrigation water as possible. The results are shown in Table V.

TABLE V.—LENGTH OF ROOTS.

Plat No.	Series	Amount of Water Applied at Each Irrigation	Year 1916	1917	1919
		Inches	Inches	Inches	Inches
29	I	2	36	48	52
33	IV	2	48	50	60
21	I	5	54	58	67
28	IV	5	60	60	68

The first measurements were made in 1916, two years after the seed had been sown. As the plants grow older the roots become longer, as shown in the results for 1917 and 1919. The plats receiving five inches of water at each irrigation show the largest root development, there being more moisture at greater depths in the soil.

TABLE VI.—SHOWING AMOUNTS OF WATER APPLIED AND YIELDS OF HAY PER ACRE.

Plat number	Inches of water applied at each irrigation	Series	Treatment	Yield of Cured Hay, in Pounds				Acre-Inches of Water Used			
				1916	1917	1918	1919	1916	1917	1918	1919
1	4	III	C*	15685	14721	17278	14072	56	56	60	60
2	2	I	C	12588	11013	12310	10994	36	36	36	28
4	5	I	C	13404	13071	12218	14312	45	50	40	50
5	3	II	C	11050	11365	10344	10438	42	39	39	36
6	3	II	CC	8991	11106	11134	10623	39	42	42	38
7	5	II	C	13404	13645	15165	13515	60	60	55	49
9	4	IV	C	11883	12163	14545	12884	48	44	48	39
10	3	IV	C	13997	14015	15277	13275	51	48	51	38
11	2	IV	C	10901	10864	12662	11403	36	34	38	32
12	5	III	C	12291	13886	13534	13329	55	60	55	55
14	4	II	CC	12031	12458	11568	11420	48	48	44	44
15	3	IV	C	11959	11420	10438	9270	48	42	45	39
16	2	III	C	8249	8639	8676	9380	34	32	34	32
17	5	IV	C	14534	14609	15778	16038	60	60	60	55
18	3	III	CC	9658	9920	9836	10456	42	42	42	36
19	3	I	C	11810	11031	8695	10461	45	39	36	30
20	4	I	C	12032	11364	10846	10401	48	40	40	32
21	5	I	C	10974	12181	12662	14295	45	45	45	45
22	4	I	C	13032	12144	12756	12719	48	44	48	40
23	4	II	C	11234	9900	9493	10271	40	40	36	36
24	3	I	C	12198	12256	12200	12255	48	45	48	48
25	2	III	C	11977	11106	7675	6248	36	36	40	34
26	3	II	C	12682	12589	11420	10993	45	45	48	42
27	4	III	CC	12718	11828	10567	10827	48	44	48	44
28	5	IV	C	14905	15053	14914	15055	65	65	60	60
29	2	I	C	9103	8194	7110	8528	32	28	30	26
30	3	I	CC	8306	10456	9799	8157	39	45	42	30
31	4	III	C	11513	14703	14617	15703	48	52	52	52
32	3	III	C	12644	11031	12115	11364	51	42	48	39
33	2	IV	C	11309	10569	10003	10[illegible]	42	38	40	32
34	5	III	C	14066	13237	13367	14387	60	55	50	50
35	2	II	C	11310	11328	11151	10679	38	34	36	24
37	4	IV	C	11068	10660	11328	10457	56	48	44	32
39	3	III	C	11123	10159	7749	7842	48	39	42	30
40	3	IV	C	10586	9066	10791	10752	45	36	45	33
41	4	II	C	12823	10641	12162	11995	52	44	48	44
42	5	II	C	12161	8696	11903	12848	50	45	45	45
44	2	II	C	8361	6730	7527	9048	36	32	32	24
47	4	IV	CC	15814	13534	13868	13274	76	56	56	48
48	5	I	CC	14404	12941	12997	13645	60	50	50	54

*The above abbreviations used in this and following tables, and the depth of soil over gravel, are explained by figure 1.

Table VI is a summary of the results obtained during each year of the investigation, and the studies which follow are based upon the figures taken from this table.

During the year 1915 the irrigations were not conducted according to the outline of this experiment. Many of the plats received less water than designated, while others received more. Therefore, the yields for that year are not comparable to those of the years subsequent and the results are not included in any of the tables.

TABLE VII.—ACRE-INCHES OF IRRIGATION WATER APPLIED.

Inches Applied at each Irrigation	According to Depth of Application Year 1916	1917	1918	1919	Average	Series	According to Series Year 1916	1917	1918	1919	Average
2	36.25	33.75	35.75	29.00	33.69	I	44.50	42.20	41.50	38.30	41.62
3	45.25	42.00	44.00	36.58	41.96	II	45.00	42.90	42.50	38.20	42.15
4	51.64	46.90	47.64	42.82	47.25	III	47.80	45.80	46.90	43.20	45.92
5	55.55	54.44	51.11	51.44	53.14	IV	52.70	47.10	48.70	40.80	47.32

When the plats are considered according to depth of application it is seen that the plats receiving the greatest amount of water at each irrigation received the greatest total amount of water applied. Also it is noticeable that more water than the average was used in 1916 and that considerably less was used in 1919. The irrigation season for 1916 was longer than for any other year, which, of course, would account for the larger amount of water applied. The irrigation season was shortest in 1919. The greatest rainfall during the irrigation season occurred in that year. Of this rainfall, there was a larger percentage of heavier showers than the average.

The larger total application on the four and five-inch plats can be attributed to some extent to the fact that according to the plan of the experiment all plats were irrigated after each cutting, regardless of the moisture content; and this procedure undoubtedly resulted in the application of more water on some of these plats than would have been the case had the minimum standard moisture content of 7 per cent been used as the index.

A consideration of the totals recorded when the plats are arranged according to soil series shows that there was an increased amount of water applied as the soil became shallower, but the increase is not as marked as is the case when the plats are tabulated according to depth of application. The increase shown is probably due to the fact that the water holding capacity of the coarse sand and gravel underlying the sandy loam is so much lower than

the latter that it was necessary to maintain a much higher percentage of moisture in the soil in order that the average of the first six feet might not fall below 7 per cent.

TABLE VIII.—YIELD OF HAY IN POUNDS PER ACRE.

Inches of Water applied at each Irrigation	According to Depth of Application — Year 1916	1917	1918	1919	Average	Series	According to Series — Year 1916	1917	1918	1919	Average
2	10475	9805	9639	9536	9864	I	11785	11528	11159	11595	11517
3	11250	11201	10742	10506	10925	II	11411	10856	11187	11183	11159
4	12718	12192	12639	12184	12433	III	11992	11932	11451	11361	11684
5	13349	13105	13615	14158	13357	IV	12696	12195	12960	12242	12523

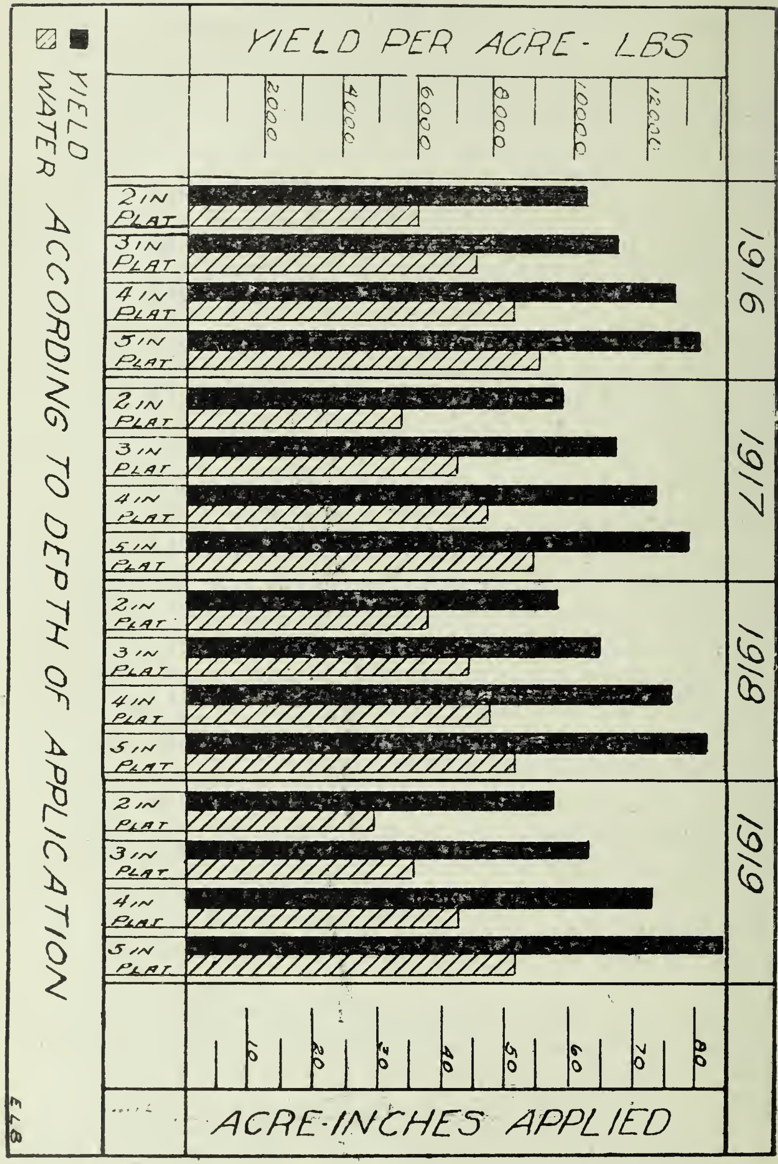
The yield per acre shows an increase with each successive increase in the depth of application of irrigation water. The increase in yield from the three-inch plats to the four-inch is the greatest, being 13.8 per cent; while the increase from the two-inch to the three-inch and from four-inch to five-inch are more nearly the same, being 10.7 per cent and 7.4 per cent, respectively, with the former being the larger.

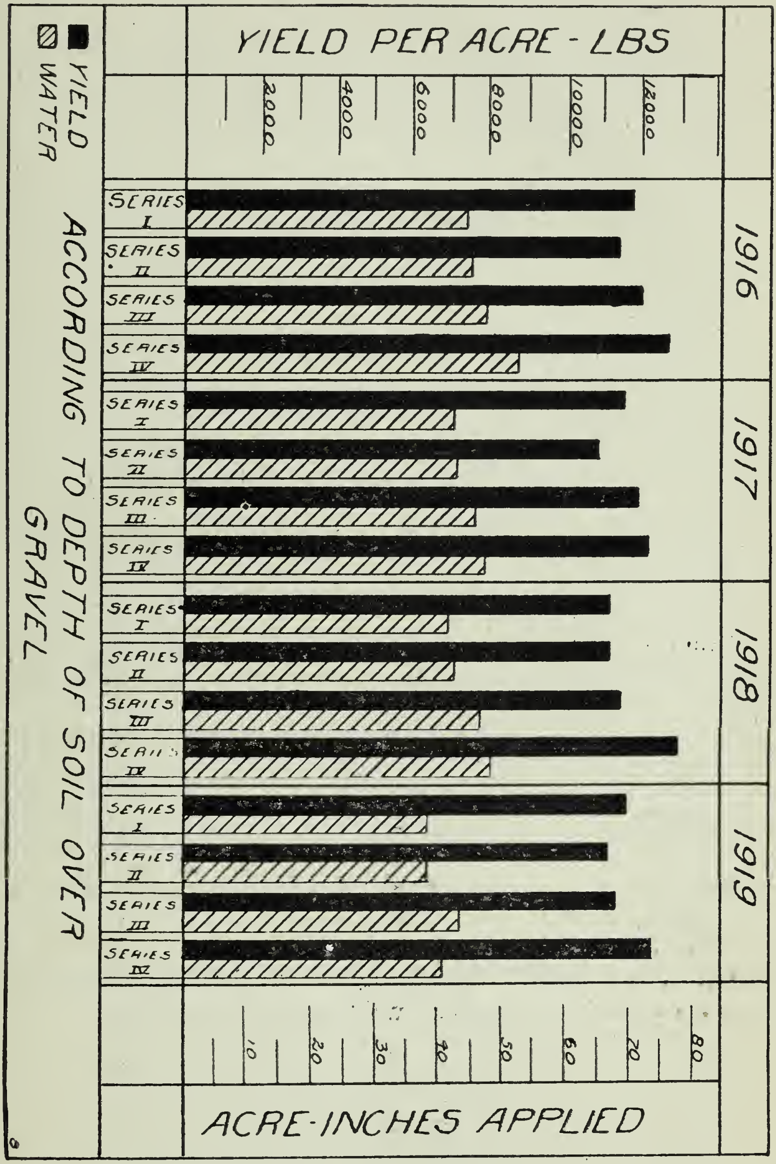
The yields per acre, as shown according to series, give a slight increase for Series I, over Series II, of 3.2 per cent; while Series III, is 4.7 per cent greater than Series II; and Series IV is 7.2 per cent greater than Series III.

Comparing Tables VII and VIII, it is noticeable that with the exceptions of Series I and II, in each case the greater yield was from the plat receiving the larger amount of water. It has been considered that other things being equal, of two plats of ground, that having the greater depth of soil will produce the better crop. This seems to be borne out with Series I and Series II. The amount of water applied was very little larger on Series II,—about ½ inch—and the deeper soil produced the larger crop. When, however, there was a substantial increase in the amount of water applied, the crop was larger, regardless of the depth of soil.

TABLE IX.—YIELD PER ACRE PER ACRE-INCH OF IRRIGATION WATER.

Inches Applied at each Irrigation	According to Depth of Application — Year 1916	1917	1918	1919	Ave'g.	Series	According to Series — Year 1916	1917	1918	1919	Ave'g.
2	288.97	290.52	269.62	328.72	294.46	I	264.83	273.18	268.89	302.71	277.40
3	248.62	266.69	244.14	287.14	261.65	II	253.57	253.05	257.17	292.78	264.14
4	246.28	254.41	265.30	284.49	262.62	III	250.88	260.52	244.16	262.99	254.64
5	240.27	240.72	266.39	275.15	244.63	IV	240.91	258.92	266.12	300.05	266.50


YIELD PER ACRE - LBS
2000
4000
6000
8000
10000
12000
YIELD
WATER ACCORDING TO DEPTH OF APPLICATION
2 IN PLAT
3 IN PLAT
4 IN PLAT
5 IN PLAT
1916
1917
1918
1919
10
20
30
40
50
60
70
80
ACRE-INCHES APPLIED


YIELD
WATER
ACCORDING TO DEPTH OF SOIL OVER GRAVEL
YIELD PER ACRE - LBS
2000
4000
6000
8000
10000
12000
SERIES I
SERIES II
SERIES III
SERIES IV
1916
1917
1918
1919
10
20
30
40
50
60
70
80
ACRE-INCHES APPLIED

As has been noticed from the tables previously presented, the greatest variation is in the results according to depth of application and the greatest yields per acre-inch of water are on the two-inch plats. The three and four-inch plats are about the same and considerably less than the two-inch plats, while the five-inch plats are less than the four and three. As the amount of water applied during the year 1919 was less than any other year, the yield per acre per acre inch of water is higher. Again the variation in results as affected by the depth of soil is not so marked, indicating again that the amount of water applied has more effect on the yield of alfalfa on this type of soil than the depth of the soil itself.

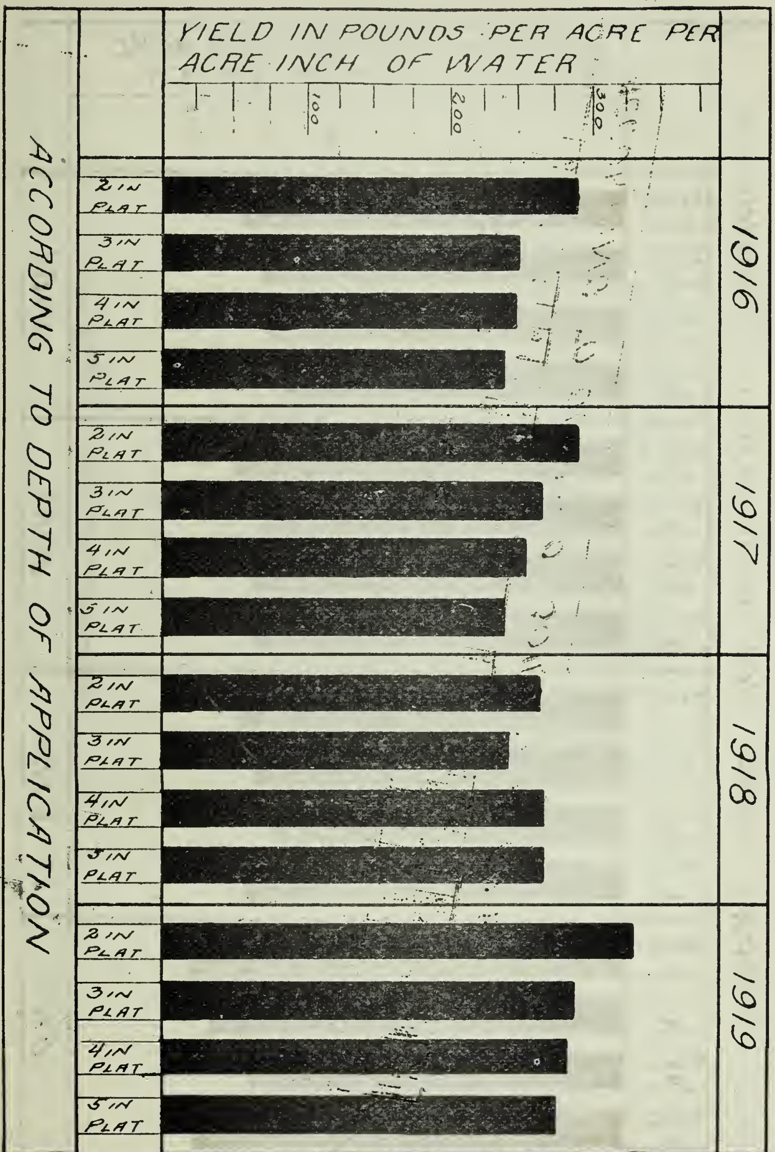
The yield of hay on the two-inch plats is probably considerably higher than would be the case if the plants depended only on the moisture available through the regular 2-inch irrigations. It was noted that the growth was very much greater around the edge of the 2-inch plats, probably due, principally, to the plants receiving moisture from the ditches and from the adjacent plats.

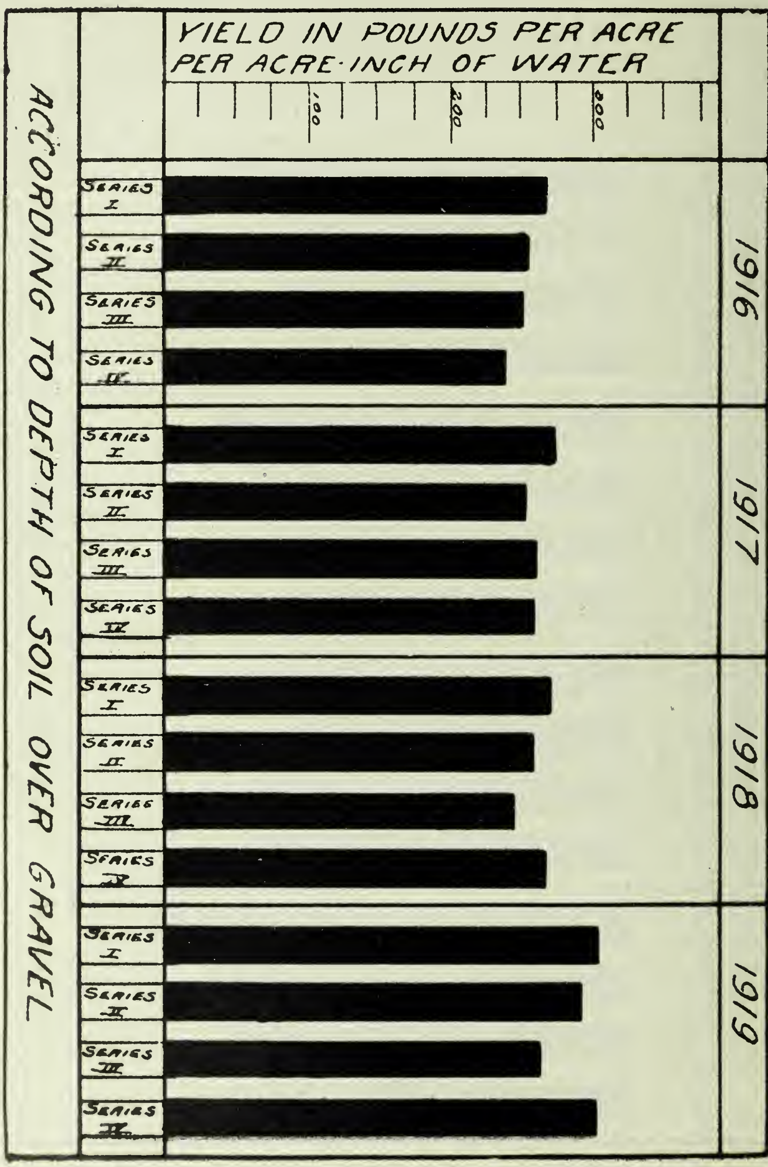
The results tabulated above indicate that the most economical yield from the standpoint of water alone is obtained when the crop is irrigated lightly and frequently.

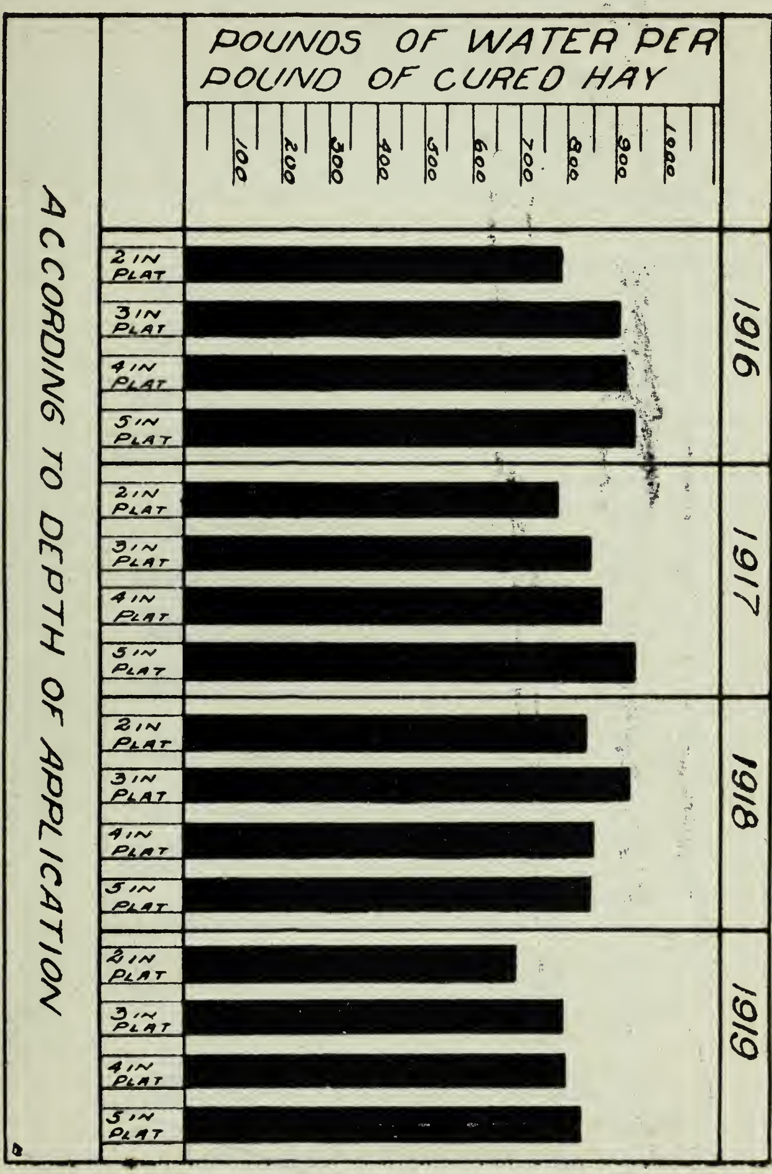
TABLE X.—POUNDS OF WATER PER POUND OF CURED HAY.

Inches Applied at each Irrigation	According to Depth of Application						According to Series.				
	Year						Year				
	1916	1917	1918	1919	Ave'g.	Series	1916	1917	1918	1919	Ave'g.
2	785.13	780.93	841.45	690.05	774.39	I	856.77	830.51	843.74	749.48	820.12
3	912.54	850.70	929.30	790.11	870.66	II	894.70	896.55	861.91	774.90	857.02
4	921.20	872.74	855.16	797.49	861.65	III	904.32	870.84	929.21	862.69	891.76
5	944.11	942.47	851.68	824.56	890.70	IV	941.74	876.24	852.53	756.13	856.66

The pounds of water required to produce one pound of cured hay is merely another way of expressing the results given in Table IX. The figures in Table X bear inversely exactly the same relationship to each other as do the figures on the yield in pounds per acre per acre-inch of irrigation water.


YIELD IN POUNDS PER ACRE PER ACRE INCH OF WATER
100
200
300
ACCORDING TO DEPTH OF APPLICATION
2 IN PLAT
3 IN PLAT
4 IN PLAT
5 IN PLAT
1916
1917
1918
1919


YIELD IN POUNDS PER ACRE
PER ACRE-INCH OF WATER
100
200
ACCORDING TO DEPTH OF SOIL OVER GRAVEL
SERIES I
SERIES II
SERIES III
SERIES IV
1916
1917
1918
1919


POUNDS OF WATER PER POUND OF CURED HAY
100
200
300
400
500
600
700
800
900
1000
ACCORDING TO DEPTH OF APPLICATION
2 IN PLAT
3 IN PLAT
4 IN PLAT
5 IN PLAT
1916
1917
1918
1919

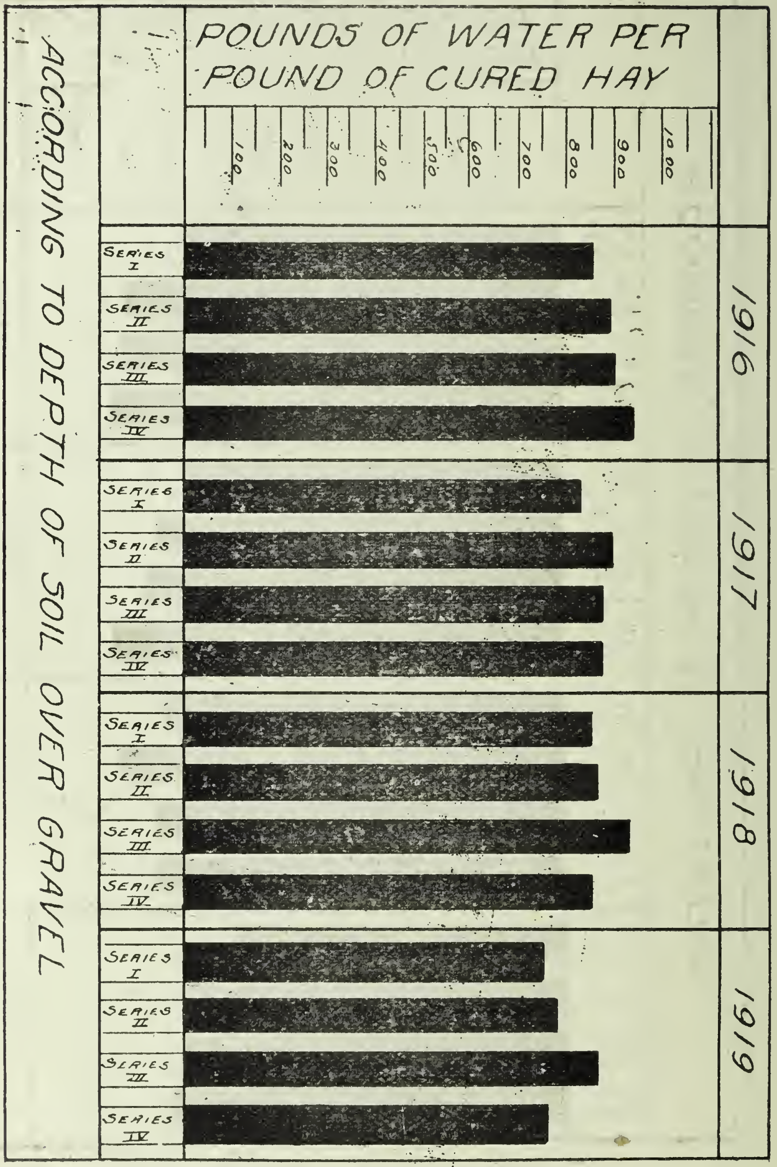

ACCORDING TO DEPTH OF SOIL OVER GRAVEL
POUNDS OF WATER PER POUND OF CURED HAY
100
200
300
400
500
600
700
800
900
1000
SERIES I
SERIES II
SERIES III
SERIES IV
1916
1917
1918
1919

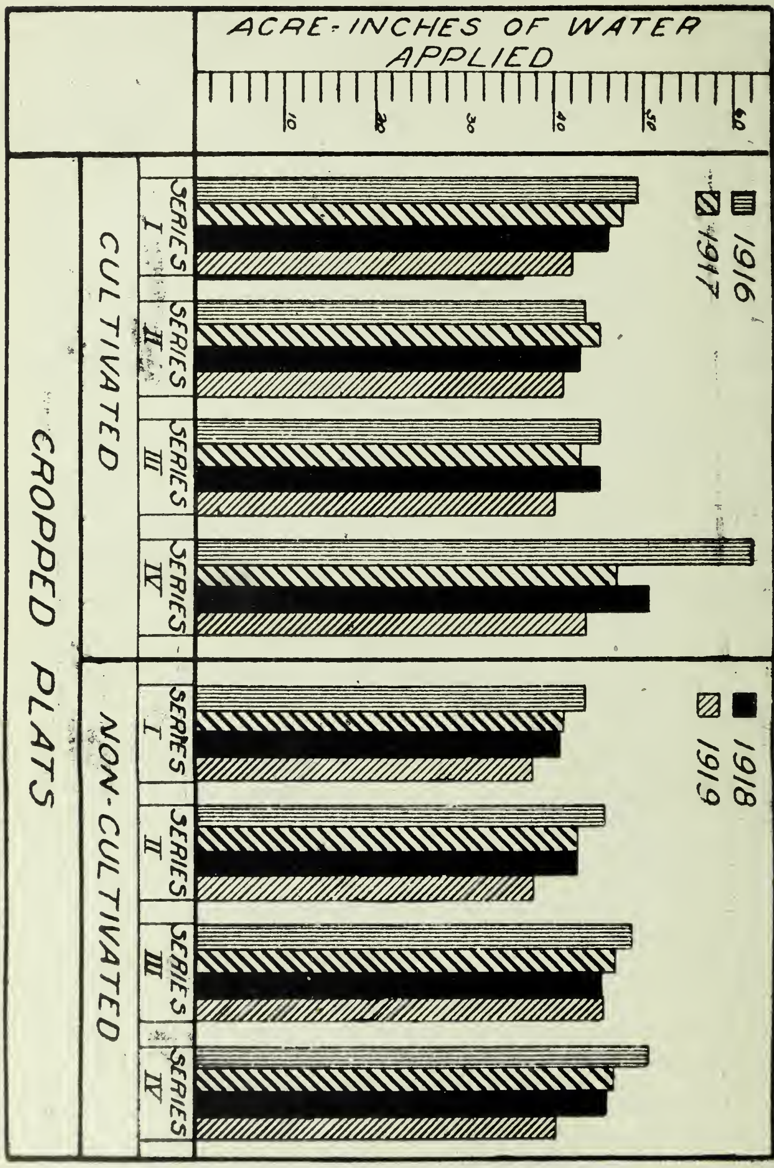
TABLE XI.—WATER REQUIREMENT AS AFFECTED BY CULTURAL TREATMENT.

Depth of Irrigation	Treatment	Acre-inches of Water Applied				
		1916	1917	1918	1919	Average
2	C	41.94	37.27	38.12	29.60	36.73
3	C	49.03	47.29	45.04	39.07	45.11
3	CC	45.59	48.34	44.12	37.82	43.97
3	F	20.19	21.20	18.01	17.10	19.12
3	CF	23.84	20.78	19.52	19.14	20.82
4	C	52.67	50.64	49.44	43.02	48.94
4	CC	59.61	53.58	51 27	47.41	52.47
4	F	32.92	31.30	25.40	25.14	28.69
5	C	57.80	60.03	51.71	52.50	55.51
5	CC	61.97	57.23	52.90	54.67	56.69
5	F	32.84	30.86	26.26	29.50	29.86
5	CF	34.16	31.39	26.03	29.07	30.16

In Table XI the water used includes the water added by irrigation and rainfall, and also accounts for the difference in the amount of water in the soil at the beginning and at the end of the growing season. Thus the amount of water shown in the table is the water that was used by the plants or evaporated from the soil, except on the five-inch fallow plats, where there was some water lost by percolation.

Plats that were cultivated after irrigation required a little more water than similar plats that were not cultivated. For example, the average amount of water for four years used on the three-inch fallow and the three-inch cultivated fallow plats was 19.12 inches and 20.82 inches, respectively. Thus the cultivated fallow plats used 1.7 inches more water than the uncultivated plats during the growing season of alfalfa. Moisture determinations made to a depth of ten feet on some of these plats showed that the water was not lost by percolation; therefore, this amount of water was lost by evaporation from these plats. On the five-inch fallow and cultivated fallow plats considerable water percolated beyond the depth of ten feet, as shown by moisture determinations. The effect of cutivation alone on evaporation cannot therefore be accurately shown from the figures for these plats.

On the cropped plats water did not percolate beyond the reach of plant roots, and on the four-inch cultivated cropped plats there were 3.53 inches more water used than on the four-inch plats that were not cultivated. On the five-inch plats 1.18 inches more water were used on the cultivated cropped plats than on the uncultivated cropped plats.


ACRE-INCHES OF WATER APPLIED
10
20
30
40
50
60
1916
1917
1918
1919
SERIES I
SERIES II
SERIES III
SERIES IV
CULTIVATED
NON-CULTIVATED
CROPPED PLATS

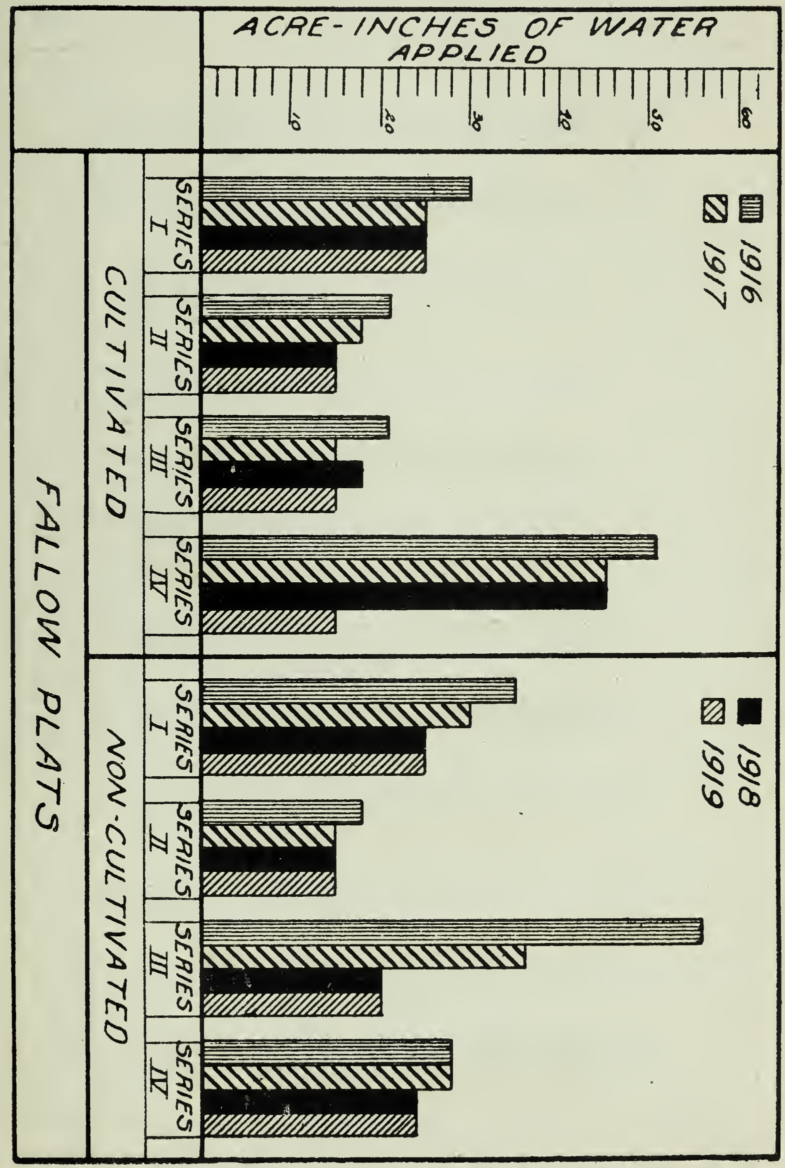

ACRE-INCHES OF WATER APPLIED
10
20
30
40
50
60
1916
1917
1918
1919
FALLOW PLATS
CULTIVATED
NON-CULTIVATED
SERIES I
SERIES II
SERIES III
SERIES IV
SERIES I
SERIES II
SERIES III
SERIES IV

TABLE XII.—TOTAL YIELD OF CURED HAY AS AFFECTED BY CULTURAL TREATMENT AND DEPTH OF APPLICATION.

Pounds per Acre

Inches	Treatment	Year 1916	1917	1918	1919	Average
2	C	10475	9805	9639	9536	9864
3	C	12011	11439	11074	10945	11367
3	CC	9728	10728	10302	9626	10096
4	C	12416	12037	12878	12288	12405
4	CC	13521	12607	12001	11840	12492
5	C	13217	13126	13693	14222	13564
5	CC	14404	12941	12997	13645	13497

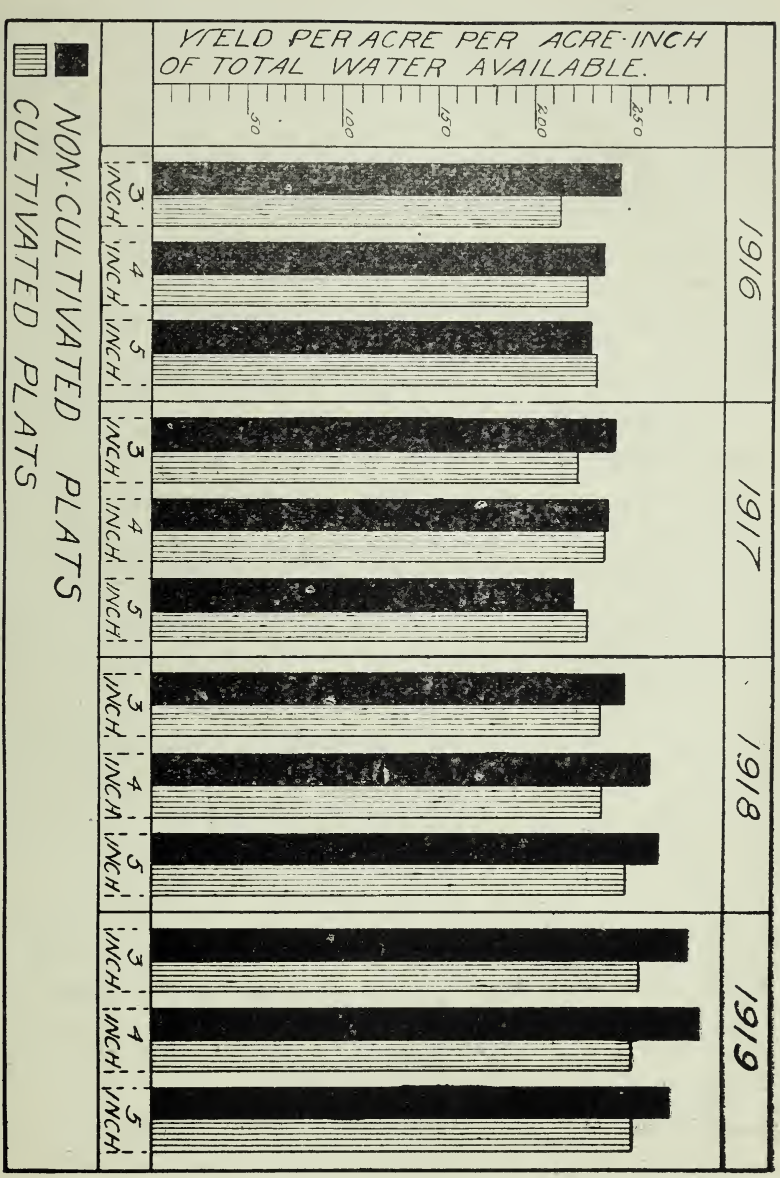
Table XII shows that the yield of alfalfa increases with the amount of water used, up to a depth of about 55 inches, which was the maximum amount of water used. The average yield on plats that were seeded in rows and cultivated does not differ very much from those that were seeded solid and not cultivated, except in case of the three-inch plats. Here the yield is considerably less on the cultivated plats. The results show that it is not advisable to seed alfalfa in rows and cultivate it after each irrigation, on this type of soil. The yield would have to be considerably more in order to pay for the expense of cultivation. Again, when alfalfa is seeded in rows and cultivated, it is more difficult to harvest, because the mower will not cut it clean and it is more difficult to rake.

The results of cultivation on the yield of corn, as recently reported by Mosier and Guftason (3), and also by Cates and Cox (4), show a decrease in the yield of cultivated plats over similar plats that were not cultivated, but where the weeds were kept down with a hoe without making a mulch. The results they secured with corn were similar to those obtained with alfalfa in these experiments; cultivation not increasing the yield.

TABLE XIII.—YIELD OF CURED HAY PER ACRE-INCH OF WATER APPLIED AS AFFECTED BY CULTURAL TREATMENT.

Inches Applied at each Irrigation	Treatment	Year 1916 Pounds	1917 Pounds	1918 Pounds	1919 Pounds	Average Pounds
3	C	244.97	241.89	245.87	280.14	253.2
3	CC	213.38	221.89	233.49	254.52	230.8
4	C	235.73	237.70	260.48	285.62	254.9
4	CC	226.82	235.29	234.07	249.74	236.5
5	C	228.67	218.66	264.80	270.89	245.8
5	CC	232.42	226.12	245.69	249.59	238.4

Table XIII was compiled from Tables XI and XII and shows the yield per acre-inch of water as affected by cultural treatment. It shows that the average yield per acre-inch of water is a little less on the cultivated plats. During 1916 and 1917 the five-inch culti-


YIELD PER ACRE PER ACRE-INCH
OF TOTAL WATER AVAILABLE.
50
100
150
200
250
NON-CULTIVATED PLATS
CULTIVATED PLATS
3 INCH
4 INCH
5 INCH
1916
1917
1918
1919

vated plats yielded a little more per acre-inch of water than did the uncultivated five-inch plats. With this exception, the results as to yield per acre-inch are in favor of the uncultivated plats. This may be partly explained by the fact that the plats which are seeded in rows and cultivated are not as well shaded, thus there is more evaporation from the surface of the soil. Furthermore, the irrigation and cultivation has a tendency to leave alfalfa in ridges and thus more soil surface is exposed to evaporation.

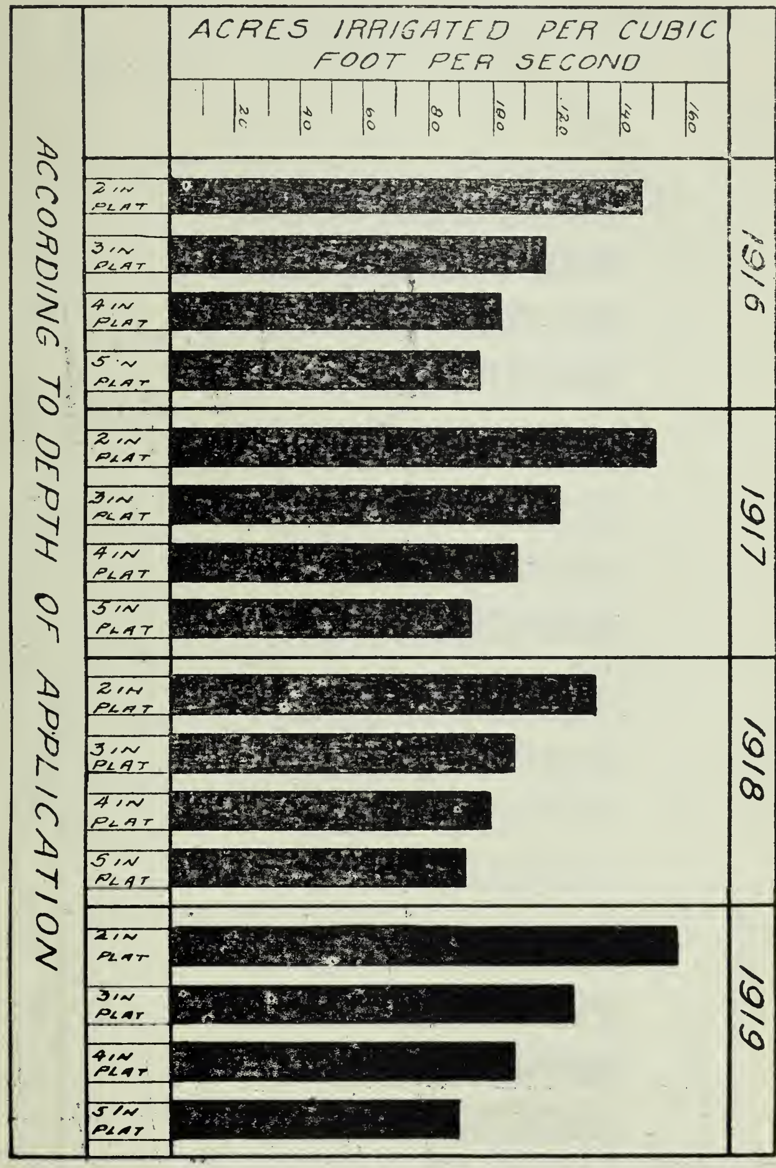
TABLE XIV.—ACRES IRRIGATED PER CUBIC FOOT PER SECOND.

Inches Applied at each Irrigation	According to Depth of Application					According to Series					
	Year						Year				
	1916	1917	1918	1919	Ave'g.	Series	1916	1917	1918	1919	Average
2	147.73	150.95	132.50	159.20	147.60	I	120.36	120.69	114.14	120.55	118.94
3	118.35	121.28	107.64	126.20	118.37	II	119.00	118.73	111.44	120.89	117.52
4	103.71	108.59	99.42	107.82	104.88	III	112.05	111.20	101.00	106.89	107.78
5	96.41	93.56	92.68	89.74	93.10	IV	95.12	108.14	97.27	113.17	103.42

These figures may be defined as the net duty of water, since no account is taken of the rainfall or the amount of water stored in the soil, and they represent the number of acres of each depth of application or depth of soil that would be irrigated by one second-foot of water flowing continuously during the irrigation season. The duty of water is the term used to express the relationship between the amount of water used and the area irrigated.

The table shows that the duty of water is highest on the two-inch plats, regardless of soil conditions, and the values become successively less until the lowest value is reached for the five-inch plats. The decrease is most marked between the two and three-inch plats, while the decrease between the others is approximately the same.

When these values are tabulated for the plats as arranged in Soil Series it is again evident that there is a very small margin in favor of the deeper soil. However, the difference between Series II and Series III is much more marked; while there is a slight decrease from Series III to Series IV. The difference is not so marked in the values considered as to depth of soil as they are when the depth of application is the basis of arrangement.


ACRES IRRIGATED PER CUBIC FOOT PER SECOND
20
40
60
80
100
120
140
160
ACCORDING TO DEPTH OF APPLICATION
2 IN PLAT
3 IN PLAT
4 IN PLAT
5 IN PLAT
1916
1917
1918
1919

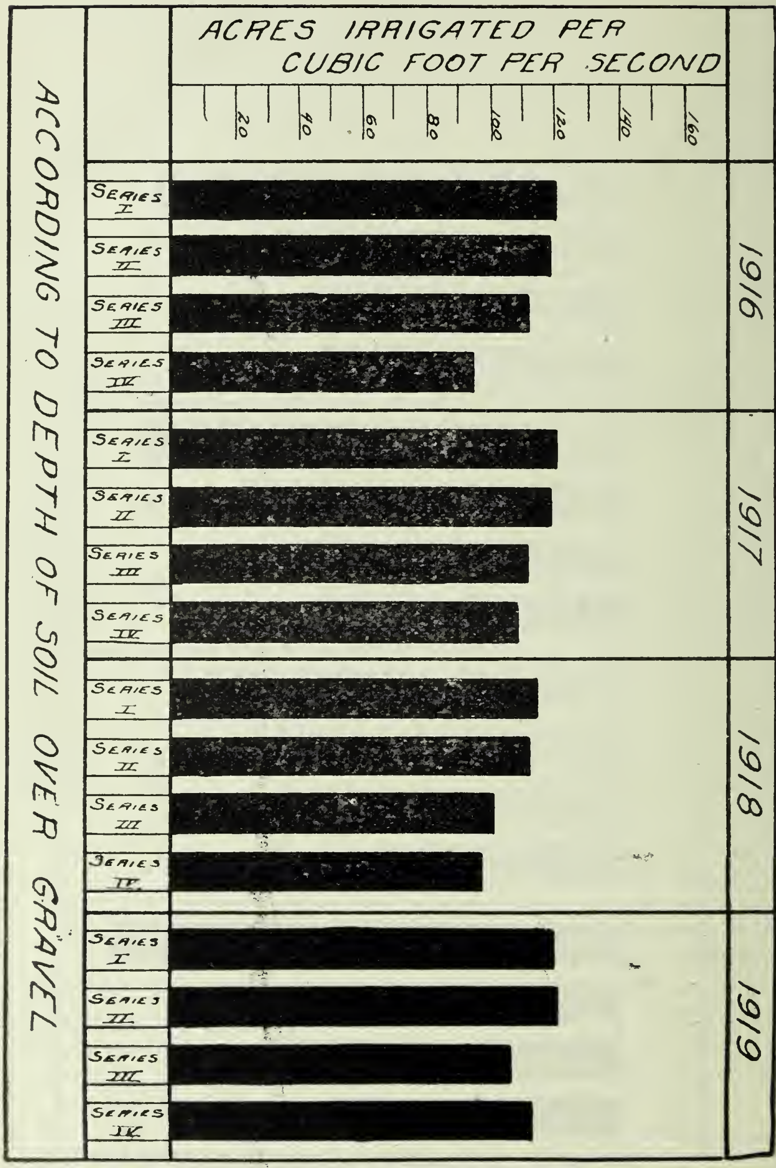

ACRES IRRIGATED PER CUBIC FOOT PER SECOND
20
40
60
80
100
120
140
160
SERIES I
SERIES II
SERIES III
SERIES IV
1916
SERIES I
SERIES II
SERIES III
SERIES IV
1917
SERIES I
SERIES II
SERIES III
SERIES IV
1918
SERIES I
SERIES II
SERIES III
SERIES IV
1919
ACCORDING TO DEPTH OF SOIL OVER GRAVEL

TABLE XV.—ACRES IRRIGATED PER CUBIC FOOT PER SECOND, CONSIDERING IRRIGATION WATER, RAINFALL, AND SOIL MOISTURE.

Inches Applied at each Irrigation	According to Depth of Application Year 1916	1917	1918	1919	Average
2	127.12	136.66	124.24	154.78	135.70
3	111.38	106.92	105.88	118.58	110.69
4	97.71	98.78	94.84	103.64	98.74
5	91.51	85.28	91.32	86.90	88.75

When the total amount of water at the disposal of the crop, considering irrigation, rainfall and the difference in soil moisture before and after the irrigation season, is expressed in terms of the area irrigated, it is termed the absolute duty of water. This total amount of water has been used in computing Table XV. The figures for the amount of water used in the different soil series are not available.

A comparison of Tables XIV and XV shows that the absolute duty of water is from 5 per cent to 8 per cent lower than net duty, but the values themselves bear nearly the same relation to each other as in Table XIV. There is a greater relative difference between the two-inch plats than there is for the five-inch, probably due to the fact that the moisture content at the end of the season was higher in the latter than in the former.

It is problematical what effect the rainfall has in actual value to the crop. A crop cannot be grown under rainfall alone, at the Experiment Station. About 78 per cent of the rain during the growing season falls in showers of .2 inch or more, and there are very few of these that are over .5 inch. Also, at the time of greatest rainfall the evaporation from a free water surface is at the maximum.

Distribution and Movement of Moisture in the Soil

At the beginning of the season of 1916, extensive studies were inaugurated regarding the distribution and movement of moisture in the soil.

Eight plats were selected for this work. Four of the plats were fallow and four were cropped to alfalfa. Two of the fallow and two of the cropped plats received three inches of water at each irrigation; and the other four received 5 inches of water at each irrigation. These plats were irrigated the same as the rest, i. e., all plats were irrigated at the beginning of each season and after each cutting of alfalfa. They were further irrigated when the average moisture content of the first six feet fell to 7 per cent, as

determined by sampling every ten days. Moisture determinations were made for each foot, to a depth of ten feet, immediately before irrigation and one, two, four, seven, and ten days after irrigation, for the purpose of studying movement and distribution of moisture.

TABLE XVI.

AVERAGE PERCENTAGE OF MOISTURE OF ALL SAMPLINGS FOR SEASONS 1916, 1917, AND 1918 OF PLATS SAMPLED TEN FEET DEEP.

Before Irrigation	After Irrigation 1st day	2nd day	4th day	7th day	10th day	Before Irrigation	After Irrigation 1st day	2nd day	4th day	7th day	10th day
		Plat 3, 5" CF						Plat 8, 3" CF			
7.2	12.9	11.4	11.1	10.1	9.7	7.4	11.4	10.2	9.5	9.5	8.8
6.7	11.3	10.5	9.1	8.8	8.5	7.7	12.4	11.3	9.7	10.4	9.7
6.7	9.7	8.5	7.5	7.6	8.6	6.6	10.2	8.7	8.7	7.4	8.8
10.7	13.3	13.4	11.3	12.6	11.7	7.5	9.0	9.1	8.6	7.8	9.1
9.8	12.1	12.7	12.1	11.7	10.3	10.4	11.3	12.5	12.1	11.8	12.0
9.2	10.1	11.8	11.9	11.2	10.4	8.0	8.8	9.3	10.2	8.9	8.7
9.0	11.3	10.7	11.7	11.3	10.7	9.3	11.4	11.6	10.2	11.9	11.4
6.6	8.0	9.7	9.5	8.5	8.5	8.6	9.5	8.5	9.6	10.5	11.2
4.4	4.8	6.8	6.4	5.9	5.5	4.9	4.9	6.8	6.4	6.0	6.1
4.3	4.3	5.5	5.7	5.5	5.5	4.1	5.1	5.3	4.8	4.8	6.0
7.5	9.8	10.1	9.6	9.3	8.9	7.5	9.4	9.3	9.0	8.9	9.2
		Plat 13, 3" F						Plat 45, 5" F			
8.5	13.2	12.3	11.6	10.8	9.8	7.9	11.8	11.6	9.8	9.5	8.4
9.0	12.3	12.4	11.4	10.7	10.6	9.3	13.2	12.8	11.9	11.1	10.8
9.7	10.8	11.2	11.1	10.7	11.7	7.5	12.2	10.8	9.6	9.3	8.6
8.5	9.1	9.7	10.1	10.1	9.9	10.2	14.1	13.5	12.3	12.0	11.8
8.2	7.7	7.5	9.0	8.8	8.7	10.5	14.0	14.4	12.4	13.7	12.5
9.4	10.0	9.9	10.1	10.3	10.7	10.4	10.8	12.9	12.5	11.7	12.3
7.5	6.9	7.7	7.2	7.9	8.2	10.1	9.6	12.4	12.3	12.7	11.5
7.5	6.8	7.3	7.3	7.4	8.0	10.1	10.8	10.8	10.3	11.7	12.0
6.5	6.1	5.5	6.0	6.3	6.4	9.4	9.5	8.8	9.7	9.6	8.3
4.8	5.6	5.7	4.9	5.4	5.1	9.7	9.9	10.2	10.6	9.3	12.2
8.0	8.8	8.9	8.9	8.8	8.9	9.5	11.6	11.8	11.1	11.0	10.8
		Plat 21, 5" C						Plat 24, 3" C			
5.8	12.9	11.3	10.1	8.4	7.7	5.1	11.5	10.4	8.3	7.8	6.7
6.8	14.2	14.1	11.6	10.0	9.1	5.1	9.6	9.7	8.7	7.7	6.3
6.4	12.0	11.3	10.0	9.4	8.6	5.2	7.3	6.8	7.5	7.8	6.8
7.5	9.8	10.7	10.7	10.4	10.2	6.0	7.1	7.0	7.6	7.4	7.1
7.2	9.5	9.7	10.1	9.6	9.9	5.8	6.1	6.4	6.5	5.5	5.7
7.9	8.3	9.0	8.9	9.8	9.4	4.6	4.4	4.9	4.8	4.2	4.6
5.1	5.3	5.6	5.6	6.2	6.3	5.3	5.1	5.5	5.6	4.6	4.6
4.4	4.1	5.0	4.6	4.7	5.1	3.7	4.0	4.3	4.1	3.7	3.4
4.2	4.9	4.9	4.7	4.8	4.8	3.8	4.4	4.2	4.3	4.9	3.7
2.8	3.7	4.0	3.6	4.2	4.0	4.3	4.5	4.6	4.6	4.4	3.5
5.8	8.5	8.6	8.0	7.8	7.5	4.9	6.4	6.4	6.2	5.7	[illegible].2
		Plat 30, 3" CC						Plat 48, 5" CC			
6.3	12.5	11.3	10.0	8.9	7.8	5.1	11.1	10.2	8.9	8.0	6.4
6.2	10.0	9.5	9.0	8.4	7.2	4.6	9.2	8.4	7.9	7.2	6.0
7.5	8.1	9.0	9.2	8.5	8.8	5.7	11.1	9.9	9.3	8.6	7.3
5.8	7.5	7.4	7.7	7.5	7.3	7.7	10.8	11.0	11.4	10.1	9.5
3.6	4.0	3.9	4.3	4.4	4.1	6.1	7.3	8.7	8.6	8.3	7.6
2.9	3.1	3.0	2.8	3.6	3.8	6.7	7.5	7.9	9.0	8.4	8.0
2.5	2.9	2.5	2.4	3.5	2.6	5.6	5.7	5.9	6.3	6.1	5.7
2.7	2.4	2.4	2.3	2.9	2.6	4.4	5.2	5.1	5.3	6.4	5.6
3.5	3.1	3.7	3.2	3.5	3.3	5.2	5.3	4.8	5.6	5.5	6.3
3.8	3.2	3.6	3.3	3.5	3.2	5.1	5.4	5.1	5.3	5.5	5.8
4.5	5.7	5.6	5.4	5.5	5.0	5.6	7.9	7.7	7.8	7.4	6.8

Table XVI shows the following results:—

1. The percentage of moisture in the first foot of soil, 24 hours after irrigation, is practically the same, regardless of the amount of water applied and regardless of whether the land is cropped or fallow; variations being from 11.1 per cent to 13.2 per cent. This shows that the maximum water holding capacity of this type of soil under field conditions is about 13 per cent.

2. From 75 to 86 per cent of the water applied on the three-inch cropped plats was held in the upper four feet of soil 24 hours after irrigation; and from 70 per cent to 81 per cent of the water applied on the five-inch cropped plats wa [illegible] the upper 4 feet; while the fallow plats, which generally contained a higher percentage of moisture than the cropped plats at the time of irrigation, held only 58 per cent to 64 per cent of the water applied in the upper four feet.

3. The amount of water that percolated below the depth of four feet in the three-inch cropped plats was practically nil, there being very little change in the moisture content of the soil below the fourth foot.

Cropped plats receiving five inches of water showed from 26 to 28 per cent of the water applied from the 5th to 10th foot, inclusive, seven days after irrigation.

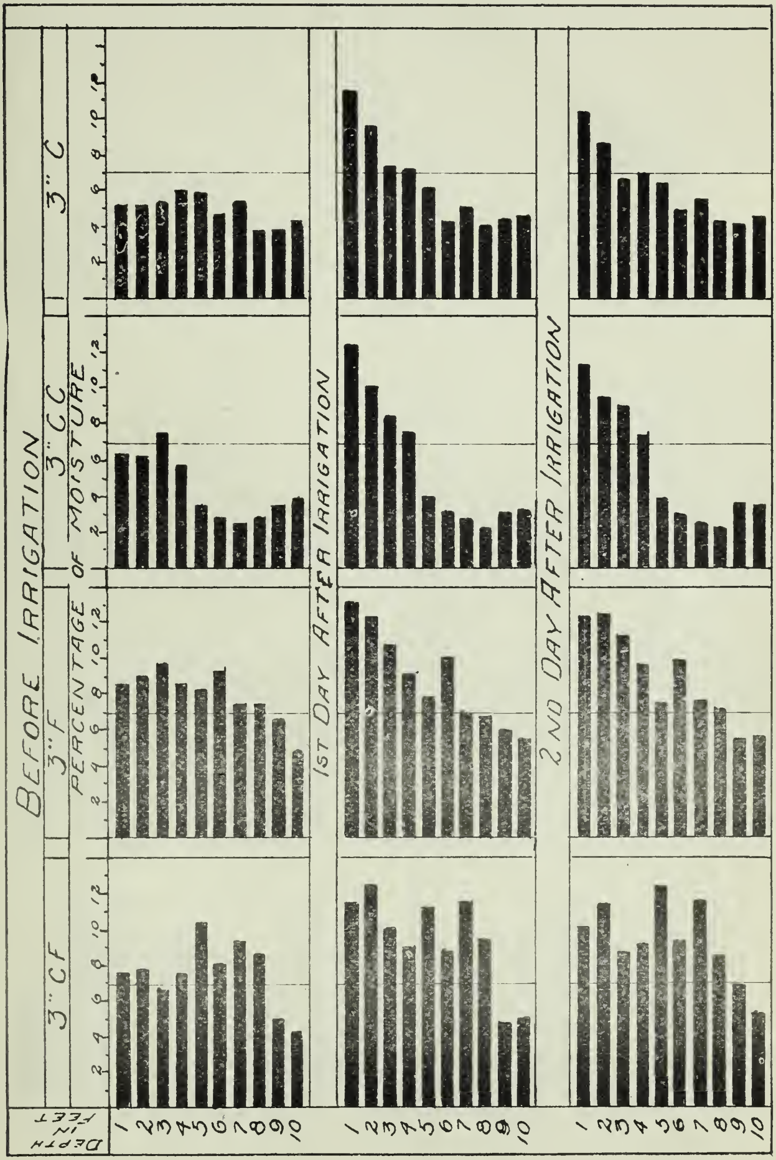
4. Fallow plats, receiving 3 inches of water, showed from 13.4 per cent to 28.5 per cent of the water applied from the 5th to 10th foot, 7 days after irrigation; while the 5-inch fallow plats showed from 30.7 per cent to 39.4 per cent of the water applied in the same depths.

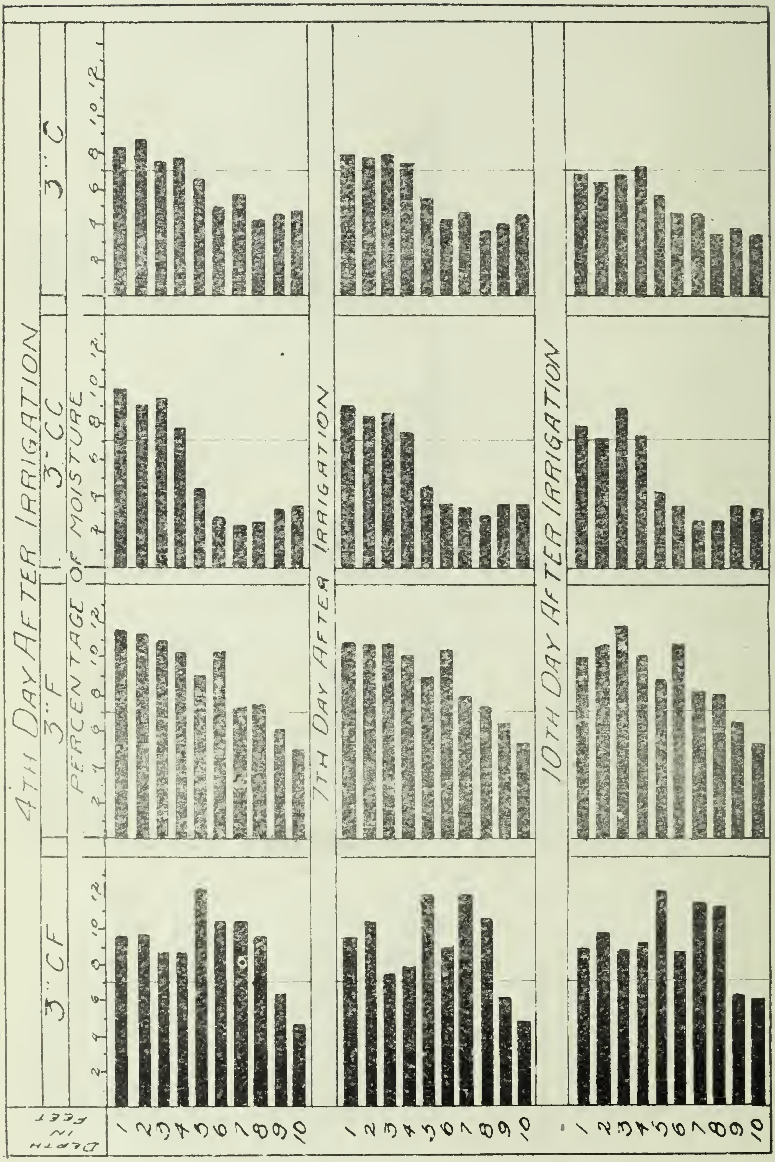
The 3-inch fallow plat showing 28.5 per cent of the water applied in the 5th to 10th foot, inclusive, was irrigated oftener than the other 3-inch fallow plat, therefore received a greater total amount of water each season; which accounts for a greater percentage of moisture at greater depths.

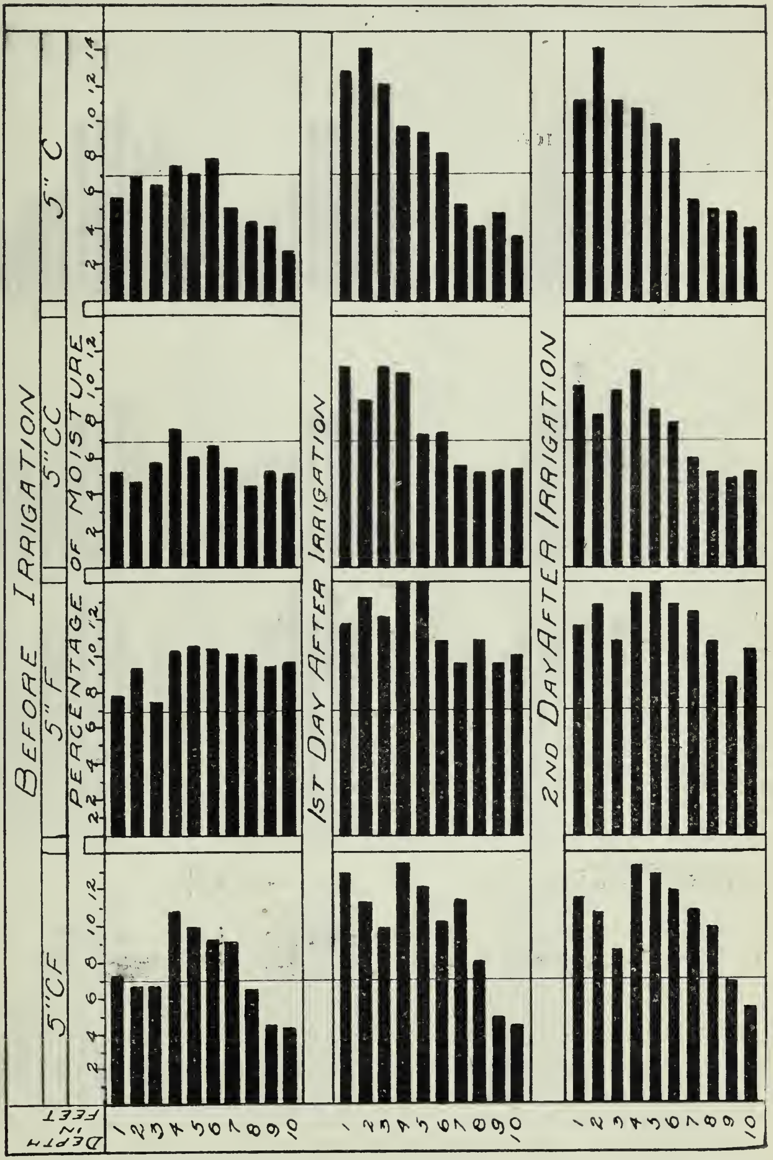
5. The average moisture content of the first foot, 24 hours after irrigation in the four fallow plats, was 0.3 per cent higher than for the 4 cropped plats. The 5-inch cropped plats contained 1.4 per cent more moisture in the first foot 24 hours after irrigation than did the 3-inch cropped plats. Both the 3-inch and 5-inch fallow plats were practically the same.

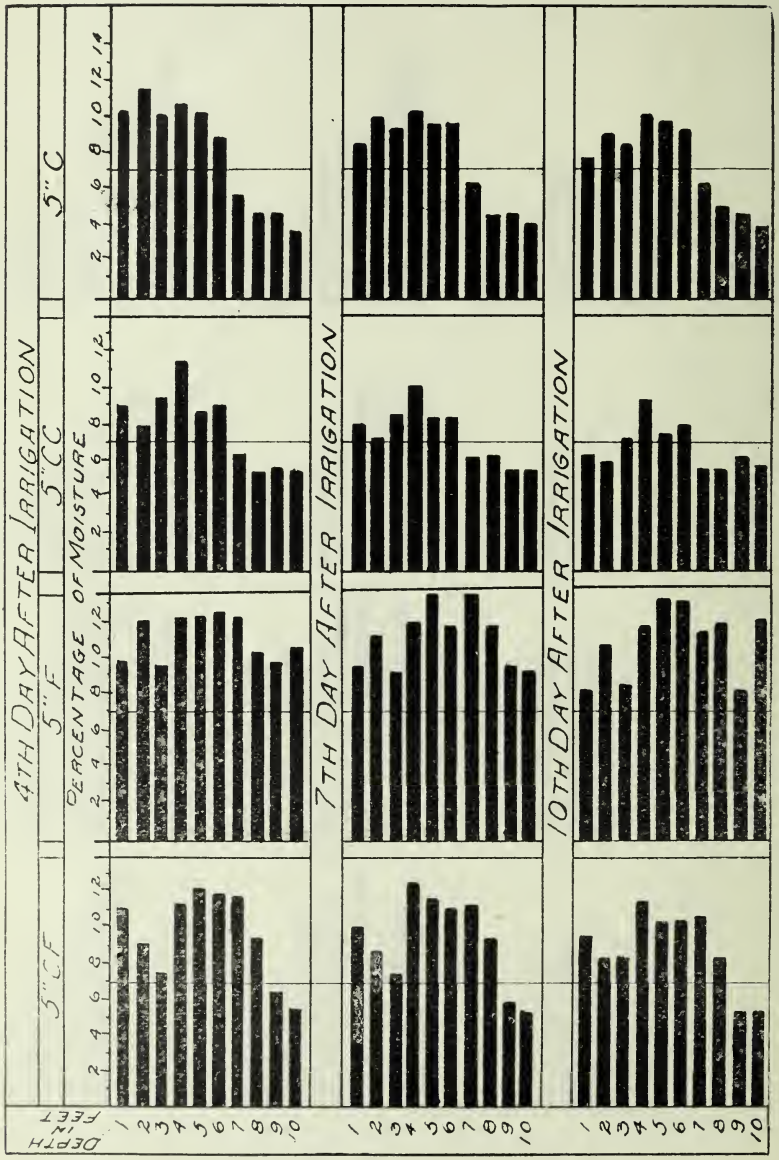
6. In comparing the effects of cultivation the table shows a higher percentage of moisture in the plats that were not cultivated than in similarly treated plats that were cultivated. Call and Sewell (5) concluded, after conducting a number of experiments to determine the effect of cultivation on the conservation of mois-

ture, that a soil mulch would not reduce evaporation on the silt loam types of soil, under Kansas conditions. Harris and Jones (6), after a four-year test, also concluded that spring cultivation of winter wheat did not conserve moisture in the upper six feet of soil. The report by Mosier and Guftason (3), furthermore, shows that the amount of moisture in cultivated plats was 0.3 per cent less, for an eight-year average, than in the uncultivated plats. The primary object of cultivation, apparently, is not the conservation of moisture, but the killing of weeds, which is of vastly more importance to the crop.


BEFORE IRRIGATION
1ST DAY AFTER IRRIGATION
2ND DAY AFTER IRRIGATION
3" C
3" CC
3" F
3" CF
PERCENTAGE OF MOISTURE
DEPTH IN FEET


4TH DAY AFTER IRRIGATION
7TH DAY AFTER IRRIGATION
10TH DAY AFTER IRRIGATION
3" C
3" CC
3" F
3" CF
PERCENTAGE OF MOISTURE
2 4 6 8 10 12
DEPTH IN FEET
1 2 3 4 5 6 7 8 9 10


BEFORE IRRIGATION
1ST DAY AFTER IRRIGATION
2ND DAY AFTER IRRIGATION
PERCENTAGE OF MOISTURE
5" C
5" CC
5" F
5" CF
DEPTH IN FEET


4TH DAY AFTER IRRIGATION
7TH DAY AFTER IRRIGATION
10TH DAY AFTER IRRIGATION
5" C
5" CC
5" F
5" CF
PERCENTAGE OF MOISTURE
DEPTH IN FEET

COST OF PUMPING

The cost of pumping water for this experiment was extremely high, due to the fact that it was necessary to use an old type of centrifugal pump which has been in use for over ten years, with an efficiency of only about 25 per cent. The motor used 21.2 K. W. per hour for 172.7 hours and delivered 107.29 acre-inches of water. The total power cost, then, per year, averaged $293.10 and the cost per acre-inch was $2.73, with current at 8 cents per kilowatt-hour. With a modern installation this same amount of water could have been pumped for approximately $1.46 per acre-inch with current at 8 cents per kilowatt-hour.

SUMMARY

1. In the experiments on which this bulletin is based, the yield of alfalfa increased with increase in total depth of water applied, regardless of soil depth.

2. The yield per acre-inch of water decreased with the increase in the amount of water applied.

3. The average yield of cultivated plats was less than that of uncultivated plats.

4. The yield per acre-inch of water was less on the cultivated than on the uncultivated plats.

5. Cultivated plats required a larger amount of water to maintain them at a given percentage of moisture, than uncultivated.

6. The duty of water decreased with an increase in the amount of water applied, and increased as the depth of soil over gravel increased.

7. With an increase of 24.5 per cent of water applied, the plats receiving 3 inches of water at each application gave 10.8 per cent increased yield over the 2-inch. The 4-inch plats gave an increased yield of 13.8 per cent over the 3-inch plats with an increase of 12.6 per cent in the amount of irrigation water. The 5-inch plats with practically the same increase of water applied, i. e., 12.5 per cent, gave an increased yield of only 7.4 per cent over the 4-inch plats.

8. Water did not percolate below the reach of plant roots with an average annual application of 55 inches on cropped plats.

9 Water percolated below the depth of 10 feet on fallow plats receiving 25 to 30 inches of water annually, but not on fallow plats receiving 15 to 20 inches annually.

10. There was very little change in the moisture content of the soil below 4 feet on 3-inch croppd plats.

11. Evaporation from fallow plats was about 20 inches during the growing season.

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BULLETIN NO. 124

FEBRUARY, 1921

New Mexico College of Agriculture and Mechanic Arts

Agricultural Experiment Station
State College, N. M.

Chile pods of desirable shape; variety No. 9.

IMPROVED VARIETY NO. 9 OF NATIVE CHILE

BY

FABIAN GARCIA

RIO GRANDE REPUBLIC
LAS CRUCES, N. M.

New Mexico Agricultural Experiment Station

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†Acting Superintendent of the Tucumcari, N. M., Field Station, operated by the U. S. Department of Agriculture, in cooperation with the New Mexico Agricultural Experiment Station.

Introduction

The word chile—usually spelled chili or chilli in the East and North—means pepper in English, and it includes all of the garden varieties of *Capsicum annuum.*

This vegetable is used extensively as a food by the Spanish speaking population of the Southwest. including New Mexico, Arizona, Colorado, California, Texas and Mexico. The demand for it among the English speaking people is also increasing annually. Many thousands of pounds of the green chile, as well as of the red pods and powdered form, are also shipped to the Eastern and Southern markets every year. Chile is used either in the green or ripe state. When used green, it may be canned or eaten immediately after it is roasted and peeled. Much of the ripe chile is ground and used in that form.

VARIATIONS

It is a difficult matter to get authentic data as to when the chile plant was first brought under cultivation in the Southwest. Like the native bean, it has been a source of food for a long time, and has been cultivated quite extensively. It is well adapted to the lower and warmer valleys under irrigation. As is the case with many other vegetables, it is not grown under dry-farming conditions, because it requires more water than that supplied by the natural rainfall in most of these dry-farming sections. There has been little or no attention given to the improvement of the varieties of this vegetable; consequently, the common cultivated chile is badly mixed, and, as a rule, of inferior commercial quality. The varieties now being grown produce pods that are irregular in form, more or less wrinkled, with thin flesh, and with a deep shoulder at the stem end. All of these are considered undesirable characteristics of the pod, and are a drawback, to a certain extent, to the canning industry, inasmuch as a fleshy, smooth, tapering, and shoulderless pod can be easily and more economically peeled. Since all of the canned chile has to be roasted and then hand peeled, the faster this can be done the cheaper it can be put on the

market. The speed in peeling the green chile pods can be materially increased by having a smooth, tapering, and shoulderless pod. Since most of the varieties of chile grown in New Mexico lack these characteristics, the Experiment Station started an investigation on the improvement of the native chile by *selection,* having in view the production of a *larger, smoother, fleshier, more tapering,* and *shoulderless pod* for canning purposes.

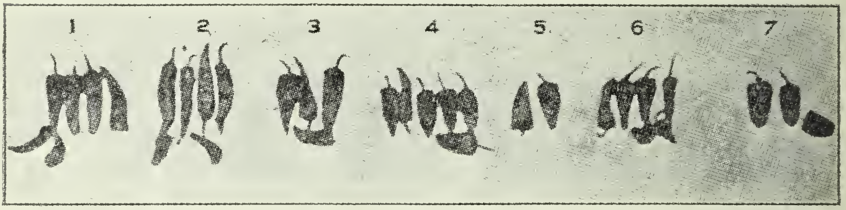

Figure 1. Variations selected for the plant improvement work.
No. 1 is a black chile variation.
No. 2 is a red chile variation.
All the other numbers are pasilla chile variations.

In Bulletin No. 67, entitled "Chile Culture," a short discussion and a picture of 14 variations of chile are given. In the spring of 1907 some preliminary work on this subject was started. Three varieties were planted, from which a number of strains were selected for future work. These were the common red, black, and pasilla garden varieties. There was a greater variability among the pasilla plants than in the other varieties. From the 30 hills planted of the pasilla chile, there were not two that were similar enough to be classified together. The variability among the plants manifested itself in a number of ways, mostly in size, color, and shape of the pods, and in the size, stockiness, and bearing qualities of the plants. Twelve of these variations were selected, and one each of the other two varieties, for the improvement work. The work has

all been done by roguing and selecting, always keeping in mind the establishing of the characteristics above mentioned.

The seed of the 14 strains selected (figure 1) was planted in a cold frame in January, 1908, and the plants were transplanted to the field in April. These plants were irrigated and cultivated during the season in the usual way. The yield, however, was almost a failure, on account of a sudden infestation of the chile wilt during July and August. This disease left but a few plants of each strain in the experimental plats. The seed for the 1909 crop was selected from the best of the surviving plants having pods approaching the ideal set forth in the plan of the experiment. The seed of these 14 strains was again planted in cold frames in January, 1909, and the plants transplanted to the field the first week in April. The wilt was again very bad, diminishing the number of plants from which seed was to be selected for 1910.

The work of cultivating, roguing, and selecting during 1910, 1911, and 1912 was the same as for the previous year. In 1912, up to July 30, there were but a few plants diseased. During August, however, and especially after the rainy season started, the disease became extremely bad, and over 95% of the plants in the experimental plats were killed.

The results of 1913 were very satisfactory. Up to this time there had been quite a marked improvement made in all of the 14 strains; especially No. 9. Figures 2 and 3, drawn from pods raised in 1913, give some idea of the improvement made; particularly in regard to shape, smoothness, and the lack of a deep shoulder at the stem end.

Numbers 9, 2, 11, and 13 had approached almost the ideal desired. Number 2 was a little too narrow and not fleshy enough. Number 11 was a little short, while number 13 was too sunken in the middle. Number 9 was the nearest to being perfect of all the varieties.

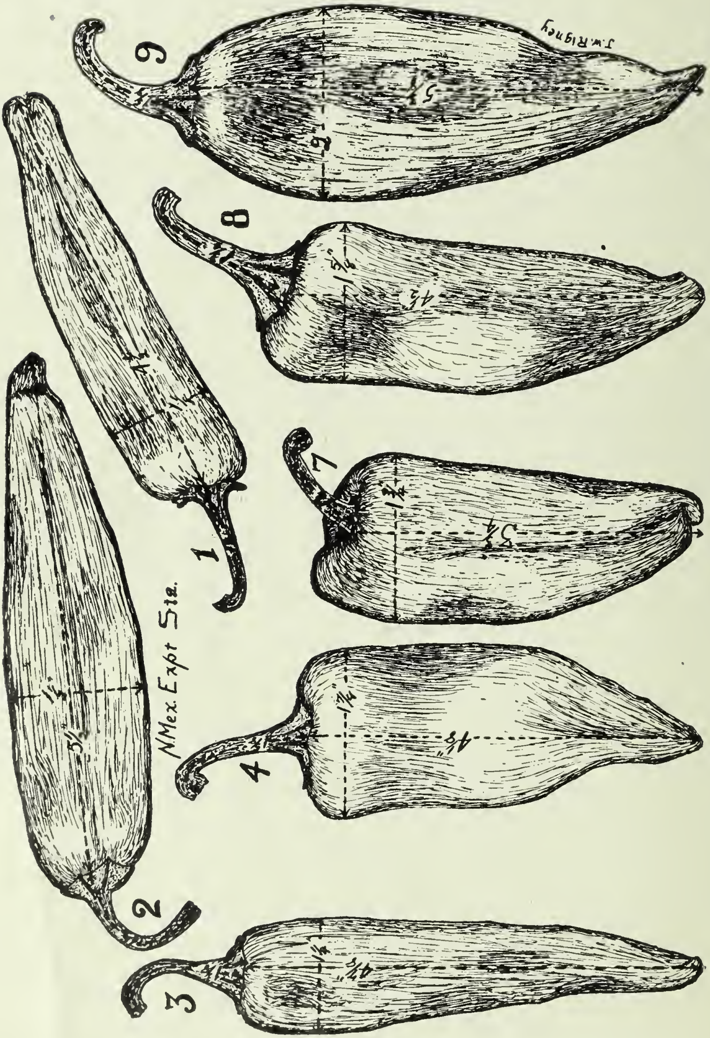

Fig. 2. Reduced to one-half natural size.

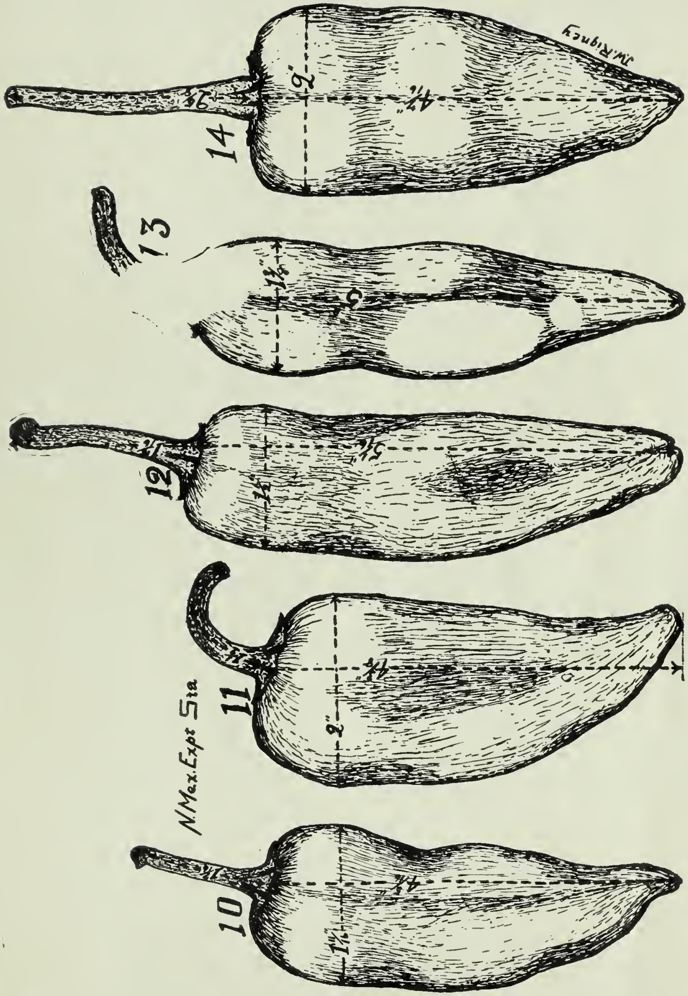

Fig. 3. Reduced to one-half natural size.

The following table shows the weights and yields for 1913:—

Chile Data for 1913

Numbers of varieties	1	2	3	4	7	8	9	10	11	12	13	14
Rows planted	2	12	4	2	3	4	4	2	4	4	3	2
Length of rows in feet	330	315	300	290	290	280	266	260	260	240	240	240
Width of rows, ft.	4	4	4	4	4	4	4	4	4	4	4	4
Area planted, acre	.06	.35	.11	.05	.08	.11	.10	.05	.10	.09	.07	.04
Hills to the row	143	136	130	128	128	121	115	112	112	104	104	104
Hills transplanted	286	1,632	520	256	384	484	460	224	448	416	312	208
Hills blighted	7	6	2	5	11	1	2	1	0	7	1	7
Hills died from other causes	73	309	96	21	55	61	15	7	106	46	32	8
Hills that bore	213	1,323	424	235	329	423	445	217	342	370	280	200
Pounds of fresh red chile picked	226	1,875	820	345	711	769	804	318	480	650	591	442
Pounds of good dried red chile	86	508	193	107	205	159	216	99	100	143	133	80
Per cent of good dried red chile	38.1	27.1	23.5	31.0	28.8	20.7	26.9	31.1	20.8	22.0	22.5	18.1
Pounds of inferior dried red chile	2	5	10	6	14	7	11	4	7	13	24	17
Per cent lost in drying	61	72.6	76.3	67.2	69.1	78.4	71.7	89.6	77.7	76	73.4	78
Weight lost in drying, pounds	138	1,362	627	232	492	603	577	285	373	494	434	345
Average yield per hill of good dried red chile, pounds	.41	.24	.47	.48	.66	.39	.51	.105	.31	.42	.20	.48
Estimated yield per acre of good dried red chile, lbs.	1433	1,451	1754	2140	2562	1445	2160	1980	1000	1588	1900	2000
Green chile picked, lbs.	10	340	70	25	60	45	36	31	40	72	27	—
Green chile peeled, lbs.	25	25	25	25	25	25	25	25	25	25	25	15
Pods green chile peeled	442	409	459	456	402	404	425	480	393	431	446	358
Weight of peeled pods, lbs.	14	15⅛	13.75	13.5	15	13.5	14.5	14	15	15	15	9
Weight of stems, lbs.	1.25	1	½	1	1	1	1⅛	⅞	1 1-16	1	1.25	7-16
Weight of peelings, lbs.	3.5	3.5	3	3.25	2.75	3⅛	2½	3⅛	2¾	3	3⅛	⅞
Weight lost in roasting, lbs.	6.25	5⅞	7.75	7.25	6.25	7⅜	6⅞	7	6.25	6	5.5	4.75
Weight in pounds and ounces of 200 pods selected for seed	2—8	3—3	3	3—2	2—4	3—2	3—4	3	3—6	3—2	3	3—6

It will be noted that number 7 shows a larger estimated yield per hill and per acre of the dried red pods than any of the other varieties, while No. 9 was second. On the other hand, the green pods of No. 7 were the lightest of all of the varieties, while those of No. 9 were third in weight. Numbers 5 and 6 had been discarded before 1913.

Seed of numbers 2, 9, and 11, was sent to sixty collaborators to be tested out under different conditions in different parts of the State.

In 1914 all but numbers 9 and 11 were discarded. Seed of these two varieties was selected and distributed among a number of collaborators. These two varieties were planted in the experimental plats during the seasons of 1914 and 1915, and were treated as in previous years.

In 1916 number 11 was discarded and about one acre of number 9 was planted, since this variety was the one that had proven to be the best. By this time the characteristics of the new strain had been fairly well established. The idea in growing one acre of this variety was to find out how it would behave under field conditions and to get some idea as to the yield from a plat as large as this. The seed was started in a cold frame and the plants were transplanted to the field about the middle of April.

The land used for this experiment had been in alfalfa for several years. It was plowed in the winter about ten inches deep. The rows were 3 1-2 feet apart and the plants, two in a hill, planted two feet apart in the row. There were 5,455 hills planted. In growing this crop the furrow or new method of growing chile was used. This method has been developed at the New Mexico Agricultural Experiment Station and consists in first plowing, harrowing, and leveling the land thoroughly, then making small shallow furrows three and one-half feet apart. The furrows can be made with a small shovel cultivator or a small plow, from three to four inches in depth. A stream of water is allowed to run down the furrows to wet them. In two or three days the plants are transplanted slightly to the sides of these furrows, and the water is turned down the rows as soon as the plants have been transplanted. In four to eight days they are irrigated again.

By using this furrow system a small stream of water can be used and the work can be done, on the whole, more satisfactorily

than in any other way. As the plants grow the dirt is ridged to them, so that by the time they are "laid by" there is a ridge from eight to ten inches high. The plants are then in the middle of the ridges with their roots deep down in the soil. This method reduces materially the amount of hand work that has to be done when the chile is first planted on ridges. The chile plant begins to bloom and bear quite early in the season and keeps blooming and bearing until frost comes in the fall. Consequently, care must be taken that the plant does not stop growing at any time during the season. This means that considerable attention must be given both to cultivation and irrigation. Everything considered, frequent and light irrigations are better than heavy ones at long intervals. This is particularly true at the present time, as the plants are liable to become infected with the chile wilt disease.

The experimental plats in 1916 were irrigated at the Station on the following dates: April 19, May 12, May 24, June 5, June 20, July 1, July 15, August 5, August 17, September 12, and October 9.

The longer the growing season and the lighter the rainfall, the larger the number of irrigations that will be required. During the season there were 198 hills that blighted and 5,257 that produced a crop. The first green pods were large enough for picking August 1. Comparatively few green pods were picked from the experimental plants. Most of the crop was allowed to ripen on the plants. The ripened crop was harvested from the 23rd to the 28th of October. The 5,257 sound hills produced 10,965 pounds of fresh red chile. This was an excellent yield. After the pods were thoroughly dried and sacked they weighed only 2,676 pounds. In other words, the one acre produced 2,676 pounds of dried red pods. Considerable care was taken in selecting the seed in the field for the 1917 crop.

In 1917 another acre was planted to No. 9 and treated the same as in 1916. It was observed during the season that there continued to be a number of hills that would still produce wrinkled pods with a sunken shoulder at the stem end. This brings up the point of how necessary it is to select the seed in the field from plants which have the pods showing the characteristics desired. The plant of No. 9 grows quite tall, varying from two to three feet in height, and it is very vigorous.

The following illustration shows the difference between the desirable and undesirable pods of No. 9:—

Fig. 4. Pods of chile showing the improved and desirable forms, and the unimproved and undesirable forms. The upper row shows 6 pods typical of No. 9. Notice the lack of shoulder at the stem end. The middle row shows 5 undesirable pods of No. 9; with deep and wide shoulder at the stem end. The lower row shows 4 of the typical native chile pods. Notice the deep, broad shoulder and small size of the pods.

The first row above are the desired pods of No. 9. The middle row shows the undesirable specimens of No. 9. The lower row gives some idea of the comparative size and shape of the native variety and the improved strain No. 9. The experimental work with this variety was completed in 1918. The characteristics of this variety are well established and by the proper method of roguing and selecting the seed in the field the quality can be kept up.

Like many other vegetables, chile varies considerably. Consequently, it is very necessary that proper attention be given to the selection of good seed. This variety is, on the whole, slightly later in maturing than the common native chile. It is better adapted to growing in the lower and warmer irrigated valleys, as it is a little too late for all of the pods to mature properly in the higher altitudes. By growing the plants in cold frames or hotbeds and trans-

planting them to the field the time of maturing is reduced and the plants do not grow quite so tall as when the seed is planted in the field.

It has been noted that transplanted plants begin to branch quicker and nearer the base than plants started in the field from seed. Growers who practice growing chile from seed planted in the field and leaving from 20 to 50 plants to the hill will meet with a great deal of disappointment, because the plants will grow very tall and have very few side branches. The nearer the base the plant branches and the more branches it produces, as a rule, the larger the bearing surface and the bigger the yield. Therefore, every effort should be made to encourage early branching of the plant, and as near the base as possible. Two to three plants to the hill give better and larger pods than 20 or more. If there are too many plants left to the hill they crowd each other too much and produce, as a rule, fewer and inferior quality pods.

Fig. 5 A plant of No. 9, well branched.

The plant of No. 9 has a tendency to grow quite tall, varying in height from 2 to 3 feet. It is very vigorous and quite prolific. Because of its tall growing and heavy yielding habits, frequently the upper branches are more or less easily broken by winds. By encouraging the branching of the plant near the base there is less damage from this source. The pods of this variety are large, tapering, smooth, fleshy and shoulderless at the stem end. The pods are light green, varying into dark green; when ripe they have a very attractive red color. On the whole, they are not quite as hot or pungent as pods of most of our unimproved varieties.

Fig. 6. No. 1, plant of native chile. Notice the small pod and small leaf. No. 2, plant of No. 9, with larger pods and leaves.

In Fig. 5 an excellent plant of No. 9 is shown. This plant started to branch close to the base and as a result, produced a heavy crop of good, large pods and was not easily broken by winds. In Fig. 6, No. 1 is a plant of the native variety. It is a little smaller and weaker-growing plant and not as prolific as No. 9. Plant No. 2 grew very tall and did not start branching close to the base. This is not as good a plant as the one shown in Fig. 5.

In originating this strain, aside from establishing the characteristics already referred to, the variety has also proved to be more resistant to the chile wilt than the native chile. The amount of injury done by the wilt can be materially reduced if precautions are taken in the selection of the proper kind of soil and in irrigating the fields so as to keep the soil moisture at about 12%.

In Bulletin No. 121 attention is called to the fact that the chile wilt is a fungus, that the germs are found in almost any kind of soil, and that the development of these germs is dependent to a large degree upon a high percentage of soil moisture. Therefore, it is very important in the growing of chile that a light soil be used, that it has good drainage, and that it is not over-irrigated.

The following are reports of some of the collaborators on the growing of variety No. 9:—

According to our tests, we found that the seed planted produced a superior and larger pod than our common varieties.

Frank C. Sanchez,
Armijo, N. M.

From the few seeds you sent me we grew some very good plants which produced very good and large pods. On the whole, the variety seems to be a little later in ripening than our native kind and for that reason it should be planted a little earlier.

F. A. Labadie,
Santa Rosa, N. M.

I planted four varieties of chile in the same plot of ground. There were two from the College, one from California, and one of the seed from last year's, grown on my ranch. The chile from the College grew tall and bore more heavily and had larger pods than the native. In fact, it was the best chile I ever saw raised here.

There was no blight in this patch but there was in a patch a hundred feet away, planted by a renter who used seed from his own place. I feel satisfied that the chile blight is caused by seed that has run out. Chile has been raised in this valley for many years and very little new seed has ever been brought in. I have seen chile blight in ground that had not raised chile before for twenty years. The chile produced a good quality of pods but a little slow in ripening.

Hugh A. Teel,
Teel, N. M.

As I am gardening in a small way I want some chile seed like you sent Mr. Watts two years ago. It was the finest chile I ever saw grow.

G. T. Davis
Roswell, N. M.

The samples of chile seed sent to me last year were planted by a Mexican working for me. A good stand was obtained. The plants were hardy and there was no evidence of disease. We raised all the green chile we used and sold some to our neighbors.

J. W. Laws,
Lincoln, N. M.

We have grown your chile No. 9 for four years. During the last two years we have grown no other kind.

In 1917 we tested out six long rows of chile No. 9, with six adjoining rows of small native chile which we had been using for seven or eight years. The results were as follows:

From the six rows of No. 9 we gathered in green chile from July 19 to August 6, 205 pounds. From the six rows of our own variety, from July

19 to August 6, we gathered 271 pounds of green chile.

We found that our own small native chile was considerably the earlier variety, as from these six rows on July 19 we gathered 25 pounds of green chile from variety No. 9, and 37 pounds from our own variety, from the six adjoining rows.

In 1919 on 2.65 acres of chile of variety No. 9 I produced 25,142 pounds of green chile.

As regards the wilt, our own variety was always so badly affected that on an average we found it very unsatisfactory, notwithstanding its extreme earliness. As regards No. 9, we lose, on an average, less than five percent of the plants, and most of the plants that are affected with the wilt are on patches of heavy black soil.

As regards marketing the chile, we find that the small native chile sells the best, but we are unable to raise it successfully; so we have discontinued growing it. We wish No. 9 was of the smaller size, as the native people prefer the small hot chile to the mild large variety.

We find that the chile does better when lightly irrigated. These results were obtained from chile started in cold frames.

Percy W. Barker,
Mesilla Park, N. M.

This office has many requests for College Chile No. 9, for seed. Farmers are realizing the value of this variety and its hardiness and resistance. Send me 25 pounds for distribution among chile growers who want same. Several extra good chile plots were ruined by the flood last May and June at Peralta and Tome. We hope to get new seed and give these farmers another start with this valuable seed. If you cannot spare us this amount of seed, I wish to request that we be advised where we can buy this variety in the Mesilla Valley, and at what prices. Our farmers are ready and willing to buy this seed if they can get it.

R. S. Conroy,
Los Lunas, N. M.

Replying to your favor of January 27, I can advise you that chile No. 9 is a vast improvement over the ordinary chile grown in this county. I have had many reports from those to whom I gave some of the No. 9 seed and all agree that it is much more resistant to blight or wilt, has smoother and larger pods, yields more, and is of a better quality. I have no data on the time of maturity.

P. J. Smith,
Hillsboro, N. M.

SUMMARY

Since all the green chile used has to be roasted and peeled, the smoother and fleshier the pods are, and the more sloping the shoulder, the quicker and better the work can be done and the less waste there will be.

When thin fleshed and wrinkled pods lie on the vegetable stand for some time before the consumer buys them, the work of roasting and peeling becomes more tedious and wasteful.

While No. 9 is not quite as hot or pungent as most of the unimproved varieties, it seems to be hot enough.

Most of the plants of No. 9 produce pods having the characteristics desired, but there are always some plants in the field which tend to revert back; consequently, it is very necessary to select the seed in the field.

Because of the fact that this variety is a little later in ripening, wherever possible the plants should be started in cold frames or hotbeds and then transplanted to the field, particularly in the higher altitudes.

Early branching of the plants near the base should be encouraged. Two to four plants to the hill give better results than twenty or more.

The work with this variety has been to improve it for canning purposes and there has been no special effort made to produce a blight resistant strain at this time. Naturally in the work of roguing and selection, incidentally the hardier and more blight resistant plants were also selected. While this variety at the present time is not entirely immune to the blight, it does show that it is not so susceptible to the wilt as the unimproved varieties. It is hoped that in the near future more intensive work can be undertaken to produce and establish an absolutely blight resistant variety.